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A BUSY CLASSROOM

A REALISTIC APPROACH TO NUMBER TEACHING

BY

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INTRODUCTION

DURING the last few years a great change has come over educational methods for children under seven years of age. Ten or fifteen years ago progressive teachers were beginning to stress the need for individual work for children, particularly in number. Thoughtful and industrious teachers, realizing that the child ought to progress at his own rate, made a great deal of apparatus for their classes; some were wise enough to base their apparatus on a carefully developed scheme which ensured that every child who completed the scheme could reach a reasonable standard of performance. The course was a planned one, determined by the teacher, and based on the logical development of the subject; but the child was free to pursue the course at his own rate. A great many children did benefit by individual work and the more concrete approach, but most infant school teachers knew quite well that they still sent up to the junior school too many children who had failed, or were beginning to fail, in arithmetic.

Throughout the infant schools there is now a perceptible change of atmosphere. Although there are still schools where formal class number lessons take place, and many others where the formal approach is modified by individual work and the use of some concrete apparatus, teachers are becoming more and more aware of the 'activity' methods used in an increasing number of schools. Reports of these schools speak of children absorbed with what they are doing, of eager, inquiring minds, of children co-operating together and helping each other. It is natural to ask what is the basis of this method, and what are its principles, under what conditions can it be carried out satisfactorily, how is it organized, and how do its results compare with those of more formal methods. Perhaps it will be most useful to try to give a short answer to these questions in this introduction.

The basis of this method is comparatively simple: it is the realization of the importance of interest as a factor in learning. No sensible adult sets out to study a subject unless he is either

interested in it for its own sake or needs it to satisfy some other interest. Children are not so different: they are widely curious, but on the whole they want to pursue the interests which are natural to their ages. Teachers who work on activity lines are prepared to follow and work through children's interests, to take up suggestions from the children, and to use those methods suitable to the age of the children. For children of infant school age the natural approach is through playing, doing, and making. The result is to direct towards learning a great deal of pent-up energy. In many well-run formal schools children are happy and willing, as well as quiet; but it is only when they are seen engaged on activities which seem to them to have a real purpose that the urgency of their desire to learn is realized. In these circumstances their energy and their capacity for absorption and concentration would prove very surprising to people accustomed only to seeing children in a more formal environment.

Obviously if all this drive and energy is brought into schools, it will also bring with it problems. In some cases, where conditions have not been satisfactory, children have become disorderly and have not made progress in learning. The conditions under which activity methods are likely to succeed are roughly four.

The first condition is that children shall be free to experiment, explore, and construct, and that their activities shall be truly spontaneous. Unless this condition is really present, the children's zest and energy will not be fully realized.

Secondly, if children are to be active and to learn from their activities, there must be an abundance of materials upon which they can experiment and from which they can learn. If play and learning from play is to be full, rich, and vital, a great variety of material is needed. Sand, water, clay, paint, and bricks are all needed for experiment and construction. All kinds of materials for domestic play should be provided—play-house, cooking-set, tea-set, dolls, beds, prams, and clothes for dressing up. Odd materials for imaginative constructions, wood and simple tools, toys for grading, matching, and sorting into shape, length, and size, jigsaw puzzles and fitting-together toys—all

these play their part. It is through such materials that children gain their knowledge of the common things of life and develop and widen their interests; and, before long, these new experiences and interests bring the children to appreciate the need for reading, writing, and number. Rooms should be arranged so that children can readily get at the materials, and the children should be free to move about, to get what they want, and to discuss with their friends and their teacher their experiences and problems. If the materials are inadequate or unsuitable, the children lose interest and tend to become disorderly and destructive.

The third condition is one which is probably least understood. It is the condition of freedom and control. One of the really fundamental needs of childhood is security. A real sense of security can only be reached in an orderly and stable environment—an environment which children unfortunately do not always have in their homes and therefore need all the more from school. Therefore, though children should be free to explore, experiment, and follow out their interests, to allow them to be anti-social, aggressive, and destructive puts a far greater strain on little children than they are ready to bear. They need the support of a just standard of social behaviour, of a sensible and suitably organized day, of general orderliness with certain regular routines. This is the scaffolding upon which children can build their lives. These conditions are not in any way contrary to the principles of activity teaching—indeed, they are quite necessary for establishing an atmosphere in which constructive activity can take place.

The fourth condition is the attitude of the teacher herself. She should be a person of wide interests and generous sympathies, able to set and maintain a just and reasonable standard of social conduct which puts children at their ease. She should have a sense of humour and a sense of fun. She needs to be skilful in picking up suggestions and ideas from the play and conversation of children, and extending and developing them. Her part is to help the children to make, do, and learn what they want, and in a friendly, approving, and co-operative spirit to enter into the children's interests. She should be

prepared to take care over organization and to think out clearly both the matter and method of what she is to teach.

Activity methods produce problems of organization, especially with big classes. Valuable educationally as are children's spontaneous activities, they will not necessarily result in progress in the tool subjects of reading, writing, and number, unless the children's interests are to some extent directed. The first awareness that reading, writing, and number are useful and desirable skills needed in order to be able to carry out other activities satisfactorily should come to the children naturally out of their play. But these skills cannot be easily or quickly acquired without a good deal of rightly directed practice; and it is the teacher's part to see that there are opportunities for the kind of practice which will lead to a mastery of the tool subjects. This needs careful planning. Therefore most infant schools have definite practice times for the tool subjects as well. For number work such times may take the form of definite class number lessons, when some new piece of work is introduced; or a directed activity period when some children are shopping and learning to use money or other measurements in an adult way, while others are using practical apparatus; or a general practice period when children play number games and work number cards. The important general principle to keep in mind is that the discovery of a new fact should be made by the children through practical means, and not by explanation on the part of the teacher.

It cannot be stressed too much that few teachers can provide this environment for their children and get from it the results they want, unless they have thought out quite clearly how their subject develops and what adaptations must be made to meet changing situations. Careful individual records are really indispensable; otherwise, with a large group of children all working at their own rates, the teacher will never keep check on the individual progress of each child. She must arrange the number lessons so that children get a variety of experience. This is all quite within the capacity of the ordinary teacher so long as she has planned fully. The object of this book is to make suggestions for how the work can be planned, especially

in the early stages of activity methods of teaching. Many teachers hesitate to start whole-heartedly on a new method: they may have neither the necessary belief or opportunity, and quite reasonably they may hesitate to leave the known for the unknown. What is suggested here is that a beginning can be made by almost anyone, if they use the handwork and number lessons for starting to carry through a piece of work, chosen and directed by both the children and teacher together. A new technique involving a new attitude and a different relationship between teachers and children is probably better started gradually, so that confidence both in teacher and child may grow as experiment meets with success. But no one has the right to expect to get the real, far-reaching results of activity methods unless she is enlisting the genuine co-operation of the children. No one should mistake willing obedience for the drive which comes from spontaneous interest, or think that because the children work sums with cardboard coins instead of by counting with beads or shells they are pursuing activity methods.

The worth of an educational method is assessed, firstly by its effect on the children in their development both as individuals and as members of the group; secondly by their attitude towards learning; and thirdly by the amount they do, in fact, learn. Miss D. E. M. Gardner, M.A., in her book *Testing Results in the Infant School*, sets out to compare groups of children from pairs of schools of similar backgrounds but with different teaching methods. She attempts to assess not only attainment in the tool subjects but also such things as social behaviour, power of expression, and ability to follow directions. Her findings are that on the whole by the time children left the infant school, the attainments in reading, writing, and number of those taught on activity lines were as good as those of children taught on formal lines; but that in other ways they were far ahead. They were more independent and self-reliant, able to concentrate better, co-operated better in their groups, their powers of expression were more fully developed, and their attitude to learning much more vigorous and enthusiastic.

A description of a school run entirely on activity lines is

given vividly in two books by Miss E. R. Boyce, *Play in the Infant School* (Methuen) and *Infant School Activities* (Nisbet). The scope of this book, however, is concerned only with the teaching of number, and it is particularly intended to be useful to those teachers who have not previously had much experience in, or opportunity for, using activity methods. It is probable that teachers who have worked for a period on the lines suggested in this book may feel encouraged to experiment further in the direction of following the children's own interests. They will be able then to do so with a solid background of successful experience behind them, and will be saved the disheartening experience of confusion and failure which sometimes accompanies an attempt to change to modern activity methods too abruptly.

The apparatus described in this book will provide a background of interesting and proved apparatus, which will make the initial difficulties of a change from formal to activity methods of teaching less arduous at the start. No two teachers will teach in exactly the same way, and every teacher will want to add some new apparatus to modify some of Miss Williams's scheme; but this basic scheme should prove a great help especially to those who have not had much experience of teaching on these lines.

I

COUNTING

MUCH of the success of number teaching in the infant school depends upon the method of presenting number facts and ideas in the very early stages of the work. Indeed, the effects of a poor or unsuitable presentation may be the direct cause of a child's failure in arithmetic much later in his career.

Most children when they come to school have had some experience of counting. They themselves may be able to count a little, but at any rate they will have heard other people counting. Their mothers may have counted the stairs when taking them up to bed, counted out sweets, repeated counting rhymes, or played counting games with their fingers and toes. They may have listened to older brothers and sisters counting in their games of ball or skipping.

Little children are interested in counting for two reasons: because it has a place in the life of the adult world in which they are eager to join, and because they enjoy its rhythmic pattern. It is well for a teacher to bear both points in mind, and to approach the activity of counting, firstly as it arises in ordinary everyday situations, and secondly through the use of counting games and definite classroom activities which involve rhythmic counting.

Counting is incidental in the children's normal routine: the number of children present in class, the number of children who can play with the sand tray at one time, the number of pencils to be given to a group round a table, the number of crayons in the crayon-boxes. A skilful teacher will see that there are many occasions when small numbers have to be counted as a matter of course. If she is ready to seize opportunities she will find many occasions for counting arising from children's play. It is fun to discover with a child how many spoonsful of sand will fill a certain tin, how many cups and saucers are needed for a tea-party, or how many bricks there are in a tall tower.

In any good collection of nursery rhymes some traditional counting games will be found. Many of the rhymes are excellent for speech training, and most of them can be used for some kind of class activity. Some easily become finger plays, as, for instance, 'One, two, three, four, five, Once I caught a fish alive.' Others can be used for vigorous movement, for example, 'One, two, buckle my shoe.' Some can be used with simple apparatus such as bricks, beads, counters, sticks, or balls. At the end of this chapter some simple new rhymes suitable for such purposes are suggested.

There are other ways of counting rhythmically without using rhymes, and many class activities can be associated with the counting. A few ideas are suggested here, and inventive teachers will think of many more.

1. Counting the number of strides, hops, jumps, &c., to reach a given object, e.g. the window or door.

2. Counting out and threading beads into necklaces, using a repeating pattern such as one red bead, two blue beads, and so on.

3. Building bricks into trains or chimneys.

4. Setting out cherries (i.e. red counters or beads) on to small cardboard plates.

5. Throwing balls into waste-paper-baskets. Each child counts his throws, and everyone counts the number of balls in the basket.

6. Making small bundles of sticks from a large bundle.

These games require only the normal apparatus available in any reception class. With the use of a little ingenuity the teacher should be able to arrange her group so that every child plays an active part in the game—a very important factor if interest is to be maintained.

Very few of these counting activities should, at this stage, reach beyond the number 10, and when children are counting or sorting objects into groups the number in any group should not be above 5 or 6.

It is important to realize that the ability to count at this stage amounts to little more than being able to recite the number names in sequence; but if the two types of activity

suggested here are carried on side by side, the series of familiar names and the actual experiences of numbers will unite to form a true foundation for later number work. For this reason it is important that children should not be hurried in forming this preliminary number sense.

Even when children can count and are getting on to the more advanced stages of number work, counting should still have an occasional place; for it can be extended in range and developed as the children's skill increases by counting forwards and backwards, in odds and evens and, later, in groups.

Counting Rhymes

1. *Apparatus*: 10 bricks for each child.

I'm going to build a chimney pot, very, very high.
I'll build it with my bricks,
And I'll make it touch the sky.
One (Place one brick)
Two (Place another brick on top)
Three (Place another brick on top)
(Continue to number 10.)
Here 's the wind,
And here 's the rain
To knock my chimney down again.
(Knock chimney down.)

2. A game with blocks.

I'll make a train,
And go for a ride.
Here are the carriages,
Side by side.
One (Place one block)
Two (Place second block beside first)
(Continue counting and adding carriages to 10.)
Tch! Tch! Tch!
Off we go,
Ten little carriages
All in a row.
(Children push 'train' up and down.)

3. This rhyme can be played with bricks or used as a finger play.

Build a house for me.
Build a house for you.
Build a house with five (or ten) bricks,
With a roof and chimney, too.

1, 2, 3, 4, 5.
With a roof and chimney, too,
And blow the smoke right through.

4. Another finger play.

The fire's gone out,
The fire's gone out.
Pick up the sticks
That are lying about.
1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

(Whilst counting the children put up their fingers one by one.)

Lay them in turn,
Lay them in turn,
And soon the fire
Will brightly burn.
1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

(Whilst counting the children put down their fingers one by one.)

Now the sticks
Are set alight,
And the fire
Is burning bright.

5. No apparatus is needed for this game, the children acting as the birds.

One little birdie saw a big crumb.
He called to his friends,
'Will you come, come, come.
Here's a very good dinner for you to-day.'
Down came a friend and pecked away.
Two little birdies saw a big crumb,

They called to their friends,
'Will you come, come, come,
Here's a very good dinner for you to-day.'
Down came a friend and pecked away.

(Continue this rhyme to 5 or 10.)

6. Supply each child with 10 counters.

The busy hens
Will cluck and lay
Big brown eggs
In the nest each day.
Sometimes one (Put out one counter)
Sometimes two (Put out another counter)

(Continue to 10.)

Here's my basket,
Round and wide.
I will put
The eggs inside.

(Pick up eggs one by one and put them in the basket, counting to 10.)

II

RECOGNITION AND VALUE OF NUMBERS

WHILE most children experience little difficulty in learning to count, particularly if counting is taught through games and rhymes, they find the recognition of figures and the appreciation of their value a more formidable task. It is essential that the approach to this new stage should be as realistic and concrete as possible, full use being made of children's pleasure in experiment and play.

A child has three new things to learn: to recognize and be able to draw certain shapes, to associate these shapes with the series of names he has already learnt, and to realize that each new shape and name represents a value. When once a child has grasped the idea that each number has its own value, and has realized the relationship of one number to another, he has

taken a big step towards the mastery of number. Once again it must be stressed that this realization does not as a rule come quickly, and that time spent over a variety of games and activities which help to establish a real understanding of the value of numbers, is not wasted but will save much time later on.

It should be realized that, among any group of five-year-olds some at least of the children may not have reached that stage of development when they are able to distinguish the comparatively slight difference between one number shape and another. The development of this skill can be assisted a great deal by the use of such toys as insets, jigsaw puzzles, and toys for matching and grading shape, length, and colour. From a child's ability to use such toys a teacher will be able to judge his readiness to start definite reading and number work.

WALL CARDS AND NUMBER FRIEZES

These help the children to recognize figures and their corresponding number groups and are a valuable part of the furniture of a classroom. It has been found helpful to associate each number with a rhyme. The cards should be brightly coloured and a good size, not less than 11 × 9 in., and they should be hung on the walls within easy view and reach of the children. The rhymes can be used to introduce the cards and, after they have been learnt, the children often find them useful to refer to when in doubt.

It may be objected that, by learning to associate rhymes with numbers, children are learning something which they will have to unlearn later. In practice this has not been found a hindrance, for children quickly take the short cut and dispense with the rhyme—a mere glance at the picture gives the clue, and very soon even the clue becomes unnecessary.

ACTIVITIES

The following are suggestions for activities which have been found suitable at this stage. Much of the apparatus can be bought; but where home-made apparatus is required, a diagram is given to show what it is like.

1. Chimney building with bricks. The child makes a row of

chimneys, each made of a stated number of bricks of the same size. Then he puts a number ticket on top of each chimney.

2. Bundles of coloured sticks. From a big bundle the child makes smaller bundles with a given number of sticks in each. The appropriate number ticket is placed by each bundle.

3. Bead threading. From a box of large beads and number tickets the child threads the beads in ones, twos, threes, &c., with the appropriate number ticket threaded between each number group. For instance, he will start by threading one bead and then the ticket with figure 1. Then he will change to two beads and figure 2, &c. Small square tickets marked clearly with the various numbers, and with a hole punched in the corner through which the ticket can be threaded, are required. (Fig. 1.)

FIG. 1

4. (*a*) The child has a packet containing eight or more different picture tickets and the same number of tickets marked with the figure 1. He puts out the pictures and puts next to each the figure 1.

(*b*) This time the packet contains pictures which can be sorted into twos. The child puts them out in twos with a ticket with the figure 2 beside each. (Fig. 2.)

(*c*) This is repeated with groups of three, four, and five.

FIG. 2

(*d*) The same process is repeated with a mixture of 1, 2, and 3 in the same packet, and then with a mixture from 1 to 5 or 6 in the same packet. (Fig. 3.)

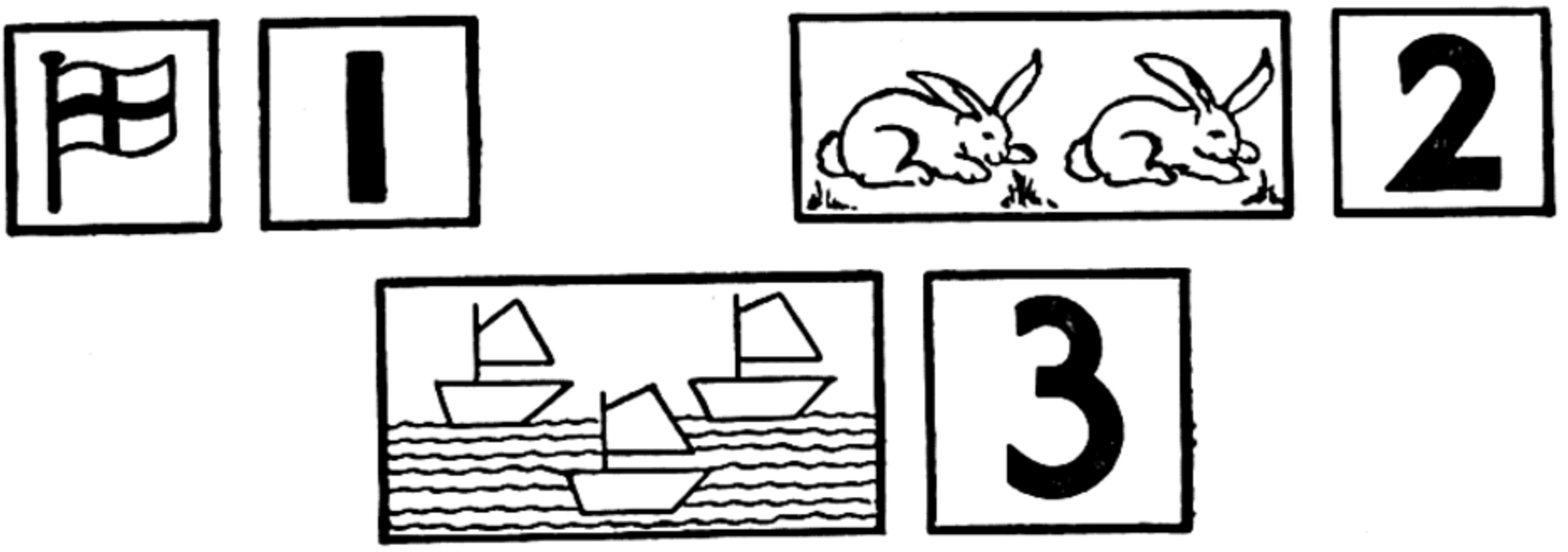


FIG. 3

5. The child has a card as shown in Fig. 4. Coloured disks in five (or six) different colours are gummed to the card. Dealing with one row at a time, the child puts beads of a corresponding colour on to the disks, and the correct figure ticket at the end of the line. When all is correct, he threads the beads and figure tickets on to a necklace.

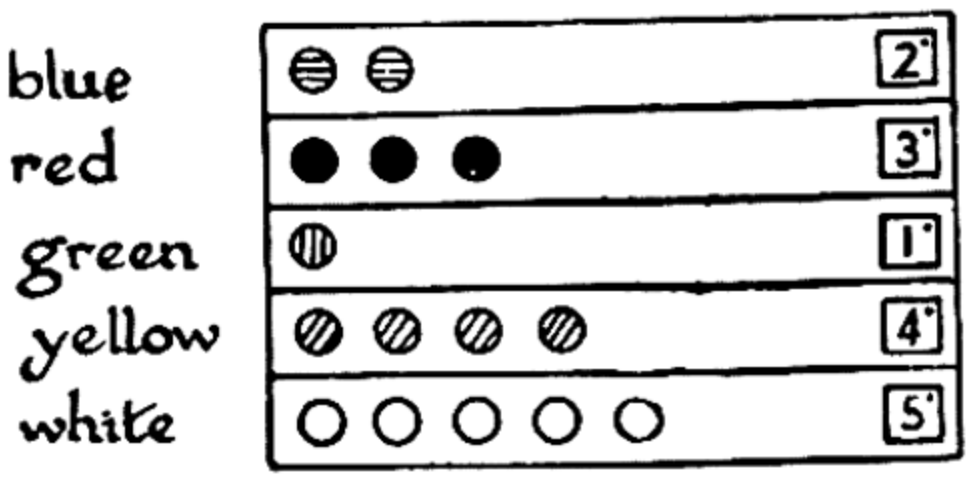


FIG. 4

As well as these activities of a more formal nature, there are many games which are very useful in establishing a sense of number value. The doll's tea-party involving the setting out of the table with the right number of cups and saucers and plates, and many other occurrences in children's natural play, all serve this purpose. Then there are the more definite number games, some of which are mentioned here.

1. *Skittles.* After the child has had his shot, he counts the number fallen and finds the corresponding number ticket.

FIG. 5

2. *Flags.* The child selects a flag bearing a number. He sticks it in the sand tray and sets up with it the correct number of coloured sticks. (Fig. 5.)

3. *Christmas bells.* Some paper bells, each bearing a number, are strung on a line. The teacher or leader rings a real bell a certain number of times, perhaps six. A child finds the correct paper bell on the line.

MAKING OF FIGURES

So far the number work has not included the writing of figures. Loose tickets have been provided for all activities, so that the actual number work should not be sacrificed to the making of figures. The writing of figures is a writing and handwork activity, and the fact that the child can write the figure 5 has little to do with his understanding of the numerical value of 5. However, it is natural that the two activities should

go hand in hand. Therefore suggestions for helping the children to master figure making are not out of place here.

Figures 1 and 4 usually present little or no difficulty, but some children require help in learning to write the curved figures 2, 3, 5. A good plan is to give these children cards on which the figure with its number picture has been cut out. (Fig. 6.)

FIG. 6

The child must be shown how to use the stencil, otherwise he will begin in the wrong place and form wrong habits of figure making. Tracing figures is another useful exercise if the outline of the figure is bold enough to be seen easily through the tracing-paper. Sets of cut-out numbers in wood or card which can be felt and handled by the children, or letters cut out of rough material mounted on card or embossed on thick card, are also helpful, for children's sense of touch is very keen at this age.

The fact, however, that a child's manipulative skill is slow in developing and his figures are bad is not a reason for holding him back on his number work, at which he may be quite ready to go forward.

III

PRACTICAL WORK ON NUMBER TO 10 AND 12 WITH APPARATUS

ALTHOUGH the teacher of a reception class may start her class together learning to count and to recognize numbers, she will almost at once realize that the children are already at different stages. Happily the old-fashioned system of rigid class lessons where the quick children waited for the slower and the slow children never really caught up at all, is practically dead. Most infant teachers attempt to solve the difficulty of teaching large classes of children of different ability either by dividing them into three or four groups or by periods of individual work with carefully graded apparatus. In this book a composite class organization is recommended. The main principle to be

adhered to is that every child ought to be able to progress at his own rate. This number scheme approaches the beginning stages of the four rules from a variety of directions, giving the child a wealth of possible activities and experiences. The four rules are all introduced early on in the scheme, first with numbers not exceeding 10. Very soon it becomes necessary to increase this a little, as the children begin to need numbers up to 12 in their activities with money, measuring, and time. The four rules are also used practically in shopping, weighing, and measuring. Thus there are roughly three kinds of lessons. There will be days when the main activity for the whole class is shopping, or measuring and weighing: details of the organization needed for such a lesson are given later. Then there are days when some new step such as the idea of giving change is introduced to the whole class; or days when the children are busy, either singly or in small groups, working through a series of practice cards or building sums out of scoring games. It is wise to introduce scoring games by a class demonstration, and to limit them to small groups when they are played among other activities: for active games, such as skittles, two children are enough at one time. One of the advantages of the scheme is that, since there are several approaches to any process—as, for example, through games, measuring, or shopping—a child who sticks over some point need not be kept back but can be given something else to do. If, for instance, subtraction is proving difficult, it is better for the child to leave that particular difficulty and go on to something else. Very often, when he has had some other experience, the child can come back to the original difficulty and tackle it without trouble. At all costs defeat, discouragement, and boredom in number work are to be avoided and achievement and success cultivated. The real skill of teaching the early stages of number lies in giving every child enough difficulty in his work to challenge and stretch him to the full extent of his ability, but not so much that he is discouraged by failure.

1. ADDITION

Most people agree that children should know by heart the essential facts of addition to 10, 12, and then to 20; for unless such facts are memorized early and become automatic, children will be handicapped in all later number work. The older school of teachers taught these addition facts by rote; but little is gained in the long run by mechanical knowledge, unless children have been introduced to the ideas through a variety of actual experiences, so that they really understand the significance of the number combinations.

Easy scoring games with ninepins or skittles are suitable activities for this stage. Balls of the home-made variety which do not roll too far and coloured beads can also be brought into use again. A few games using these are suggested here.

1. *Skittles.* (*a*) Set up a number of each of two colours. Play the game in the usual way. The child notes the numbers of skittles of each colour he has knocked down, counts them, and gives the total.

(*b*) Put a number of skittles of one colour in two groups. Each child is given two balls which he rolls in turn to each group. He first gives the number fallen in each group and then the total number.

2. *Beads.* The child is given beads of two colours, but not more than five of each. He threads a few of each colour, counts them, and threads a number ticket giving the total.

3. *Balls.* The child throws balls of two colours in the waste-paper-basket. He counts the number of each colour and then gives the total.

During these skittle and ball games the addition and equal signs are taught. Using tickets as shown in Fig. 7, the child makes, under the teacher's supervision, a sum on the floor about his play. For instance, if he has knocked down three red skittles and two blue ones, he sets out his sum in this way:

FIG. 7

These tickets should be big and solid enough to be handled easily by a small child, and the figures and signs should be bold enough to be seen by all the children in the group. When children understand how to build up addition sums with cards, then practice in working sums with numbers up to 6 can begin. This can be taken in a variety of ways. Two are suggested here.

(*a*) *Illustrated sum cards.* The child selects the correct printed number ticket or writes the answer on a slip of paper which he places after the equal sign. (Fig. 8.)

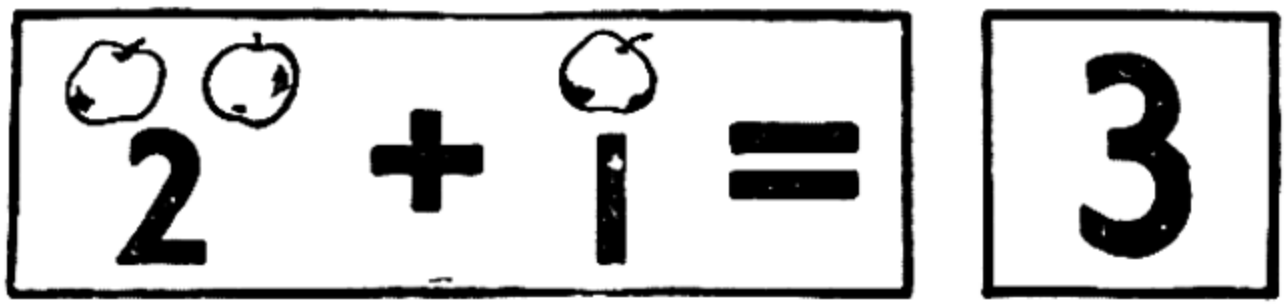


FIG. 8

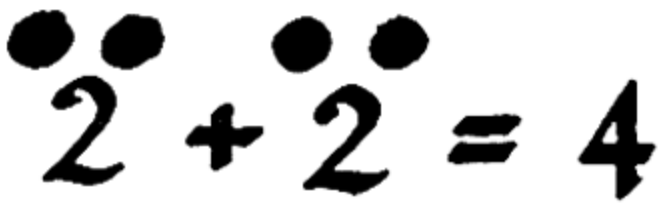


FIG. 9

(*b*) *Cards showing addition sum only.* This is a harder step. The child has to copy down the sum, draw his own pictures, and write the answer. (Fig. 9.)

APPARATUS FOR ADDITION

Each child in the group is given a card measuring not less than 10×8 in. On the card are drawn two of any of the following: trees, ponds, nests, hutches, fields, telegraph-poles. The sum card is placed on the centre of the card. The child is also supplied with a box of cut-out pictures suitable to use with his card, such as apples, ducks, birds, &c. (Fig. 10.)

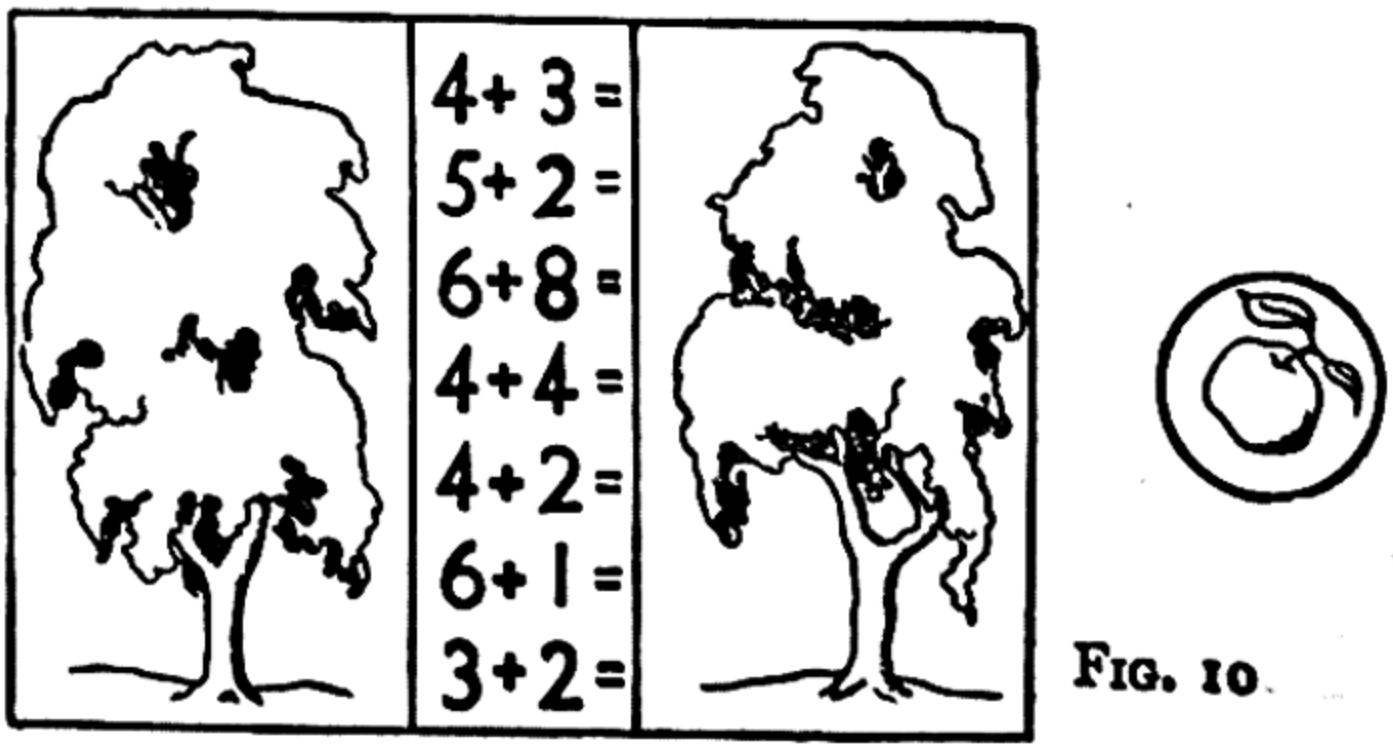


FIG. 10

To work the first sum on the card, he puts 4 apples on one tree and 3 on the other and counts to find the total. Either he writes down the sum and answer $4+3=7$ in his book, or he works the sum on the card using number tablets for the answers. It is important that the development of quick number thinking shall not be hindered by the child's inability to write easily and quickly. One possibility is for the child to work the sums as quickly as he is able, using number tablets for the answers, and to copy the sums afterwards as a record of his work. At this stage he should be encouraged to consider the greater number—4 in this case—as a whole and count on the rest. This process can be repeated with the variation of ducks on ponds, &c. Practical work of this type not only helps to stimulate interest and so develop habits of concentration, but leads to a clearer understanding of the principle underlying addition. The pictures given are mere suggestions. No doubt most teachers will find it easy to add to the list, as the greater the variety the better. There need be no fear that the pictures will tend to distract the child, which as a mere decoration for the sum card they might do, nor are they a bait to tempt a child to do what is otherwise an unsuitable activity. They are used to give the child a feeling that the sum is a situation in real life and not an abstract puzzle. They take the place of counters, sticks, and shells, with which the children have little or no experience outside the classroom.

2. SUBTRACTION

There is little need to worry about the method of subtraction to be adopted in the early stages of the work. Direct subtraction or 'taking away' is easily understood by the five-year-olds. Inverse addition and other more involved methods can be left until later.

Once more interest in a new rule starts in play. The child continues to play games with skittles, balls, bricks, beads, &c. When the time comes for subtraction to be introduced, the child, after a shot at the skittles, counts those still remaining upright, or the number of bricks left standing of a tall chimney which has crashed. He can, using patty tins, make 'tarts' in

the sand pits, pretend to have some for tea, and then count the number left over for the following day. Any game of this kind will help the child to get hold of the idea that subtraction means the reduction in quantity of a number. Rhymes dealing with subtraction can be used to advantage, especially if they call for action on the part of the child. A few are given at the end of this section.

So much for the preliminary work. The minus sign is next introduced. As with addition, this is done in connexion with games of skittles, balls, &c. The child, as before, is provided with a box of tickets including both the numbers and the signs.

Before he plays he counts the number of objects and finds the correct number ticket; he plays his game, i.e. knocks down his bricks or his skittles; he finds the minus sign and a ticket for the number fallen; he finds the equal sign and a ticket for the remaining number; and so at the end he has his sum set out on the floor, $6-2=4$, or whatever it may be.

Apparatus for Subtraction

This is of the same kind as that used for addition, with this difference. One tree, pond, hutch, &c., not two, is shown on the main card, and the sum card is placed down one side. (Fig. 11.)

Fig. 11

When working his sums the child should be asked to arrange his ducks, rabbits, &c., in number-picture formation and to remove the number stated in such a way that a number picture remains. When, at a later stage, he is required to perform the mental operation of subtraction, it will be useful to him to be

able to visualize this process. He needs much practice in working through a variety of concrete apparatus to make sure that the fundamental idea of subtraction is well established.

Rhymes for Subtraction

In the same way that counting rhymes were used as an introduction to addition so they can be used to introduce the idea of subtraction. But now instead of the total getting greater as each number is added, the total gets smaller as each number is subtracted.

1. *Falling Leaves.* Five children are chosen to represent leaves. They stand in a group facing the class. All repeat:

Five little leaves so bright and gay
Were dancing about on a tree one day.
A wind came blowing through the town:
Phe-ew,
One little leaf came tumbling down.

(At 'phe-ew' the class all blow hard at the leaves. At the word 'down' the end child sits on the floor.) The rhyme is repeated until all the leaves have been blown down. Individual children will be called upon to count the remainder after each verse.

2. A snowman stood on the snowy ground,
Ten little children danced around.
One fell down with a bump, oh! oh!
How many left to dance in the snow?

A snowman stood on the snowy ground,
Nine little children danced around, &c.

3. *The Apple-tree.* (The children may draw an apple-tree for this rhyme and use five red counters for apples.)

On the farmer's apple-tree,
Five red apples I can see.
Some for you, some for me.
Eat one apple from the tree.

(One apple is removed, the remainder counted, and the rhyme is repeated until all are gone.)

4. The children put themselves into groups of three to play this game.

Three little frogs
Sitting on a well.
One leaned over,
And down he fell.

Froggie jump high,
Froggie jump low.
Two little frogs
Jump to and fro.

(The frog who leaned over sits down, and the rhyme is repeated until all the frogs have 'disappeared'.)

5. Ten little seeds asleep there lay,
A bird flew down and took one away.
How many seeds were left that day?
Nine little seeds, &c.

6. Five brown buns in the baker's shop,
Big and brown with the sugar on top.
A boy came in with a penny to pay,
He bought one bun and took it away
Four brown buns, &c.

This rhyme can be rather suitably taught when the children have been recently making a baker's shop. It can then be dramatized and 'actual' buns used.

3. MULTIPLICATION

The next rule in order of difficulty is multiplication. This requires very careful teaching, closely related to practical experience; otherwise there is a danger of much confusion arising in the child's mind when, at a later stage, he has to apply his knowledge of the four rules to the working of problems. The child who asks 'Is it a times or a share sum?' has failed to grasp the real significance of multiplication and its close relationship to addition. The building and subsequent learning of tables is not sufficient. An intelligent child may be able at a very early age to chant any number of these with amazing facility. His ability to do so may give rise to a false notion that he has mastered the rule of multiplication, whereas only his powers of memorization have been brought into play.

He often proves to be as helpless in his efforts to discover the number situation involved in a problem as a duller child. The learning of a few tables has its uses even in the infant school, but after, and not before, the child has obtained a sound working knowledge of the meaning of the rule by practical experience with a variety of concrete apparatus.

As in the case of addition and subtraction, the principle of multiplication can be introduced through counting, and, as with the earlier counting, the children should make their first experiences with concrete material. In this case the counting is done in groups instead of in units; the first in groups of twos, then threes, then fours, and so on. Counting in the bigger groups will naturally be left to a later stage. Counting in twos is particularly attractive to children because of the rhythmic pattern and fascinating lilt. Much incidental counting of this kind can be done in connexion with other activities at various times during the day—as part of a physical training or games lesson, in connexion with a story, &c. Some suitable rhymes for use at this stage are given at the end of this section.

As in the teaching of the first two rules, the child must have his first experience of multiplication through practical activities involving the use of concrete apparatus. Where floor space is so limited that it is difficult to play active games, desk activities must serve the purpose. These are some suggestions.

1. *Matchbox trays*. Each child has 5 trays. He makes and puts 2 plasticine eggs in each. He counts the total in twos and writes down his answer.

2. *Cardboard plates*. The child puts 2 cherries (counters) on each of 4 plates. He counts them in twos.

3. *Sand tray*. He makes 3 pies, using empty cream cartons. He puts 3 flags on each and counts the flags in threes.

4. *Beads*. The child threads 2 of each of 5 colours. He counts the beads in twos, writes the answer on a ticket, and threads it.

5. *Bottles*. The provision of milk in schools has provided, in the baskets which hold milk bottles in rows of 5, an almost perfect aid for counting in fives.

Stories told and afterwards dramatized are a great help.

The teacher with an inventive mind scores here, as she can make the story fit in with the number operation she is dealing with at the time. Further interest can be added by illustrating the story on the blackboard. This is an example of such a story:

'Billy has a penny to spend. He wishes to buy a balloon, so off he runs to the market square where stands the old woman with a barrow of bright balloons. What lovely colours! There are two red ones, two blue, two green, &c. Billy stands and counts them before spending his penny. Finally he chooses a red one and then hurries home to show his beautiful balloon to mother.'

Apparatus for Multiplication

It is not as easy to make multiplication a natural part of children's play activities as it is with addition and subtraction. A game, however, such as the following may prove useful:

Materials. A number of paper plates, a dish of clay potatoes from the school greengrocer's shop, and a few large wooden spoons.

Choose five 'mothers'. Each mother sets out on her table in number-picture formation 1, 2, 3, 4, 5 plates for her children coming home for dinner. Each child is to be given 2 potatoes. Mrs. A. has one little boy. She puts her spoon into the dish 1 time bringing out 2 potatoes. Show card $1 \times 2 = \square$. A child then finds and places after the equal sign a ticket having figure 2, $1 \times 2 = \boxed{2}$. Mrs. B. has two children, so she takes 2 potatoes 2 times. Her completed card reads $2 \times 2 = \boxed{4}$. Mrs. C. then serves her three children with 2 potatoes each, and she puts her spoon in the dish 3 times in order to do so.

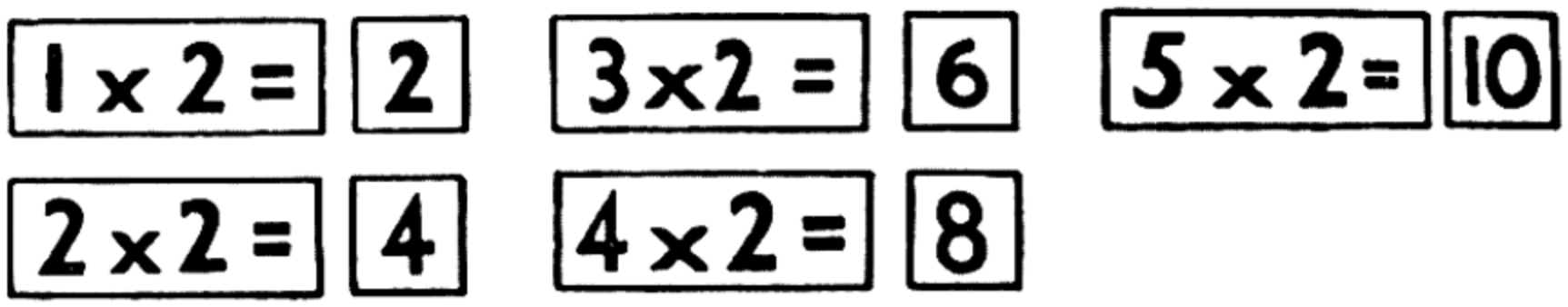


Fig. 12

When this is done, the rest of the group read the card 3×2 as 3 times 2, count the total number of potatoes on the plates in

twos, and put the figure 6. Thus the game proceeds until each mother has served her family, and all the children have seen the practical working of the five completed cards.

For the next lesson on times sums the children draw each family's plates and potatoes and write the multiplication sum by the side of each.

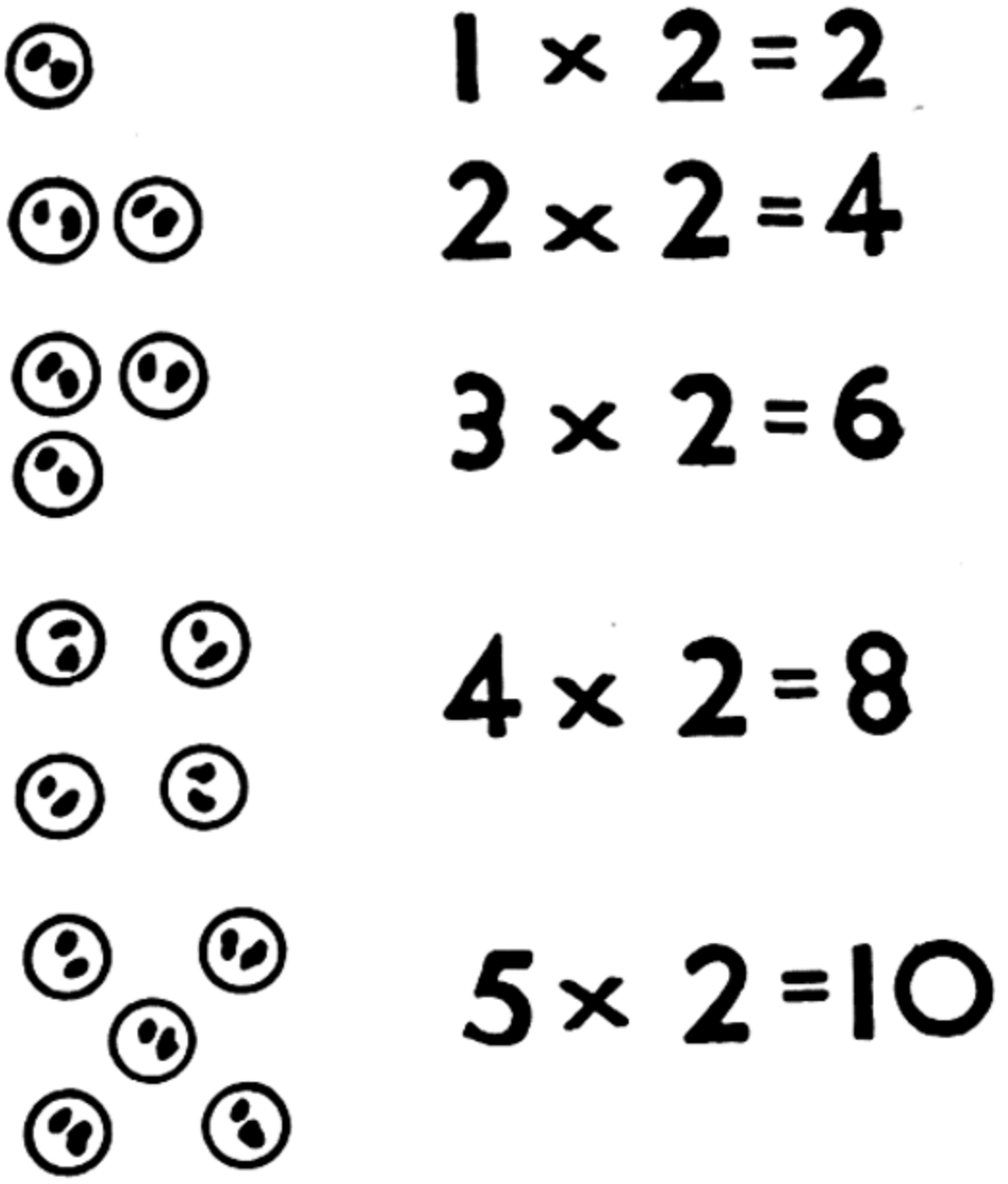


FIG. 13

Similar games can be worked out for the other number groups. But of course no reference will be made at this stage to tables. The child merely makes sums about 2's, 3's, &c. The point to impress is the working of the sum. For instance, the child is not asked to remember $4 \times 2 = 8$, but that 4×2 means the putting out of 2 four times, and by using his knowledge of group counting—2, 4, 6, 8 in this case, he can obtain the answer. This idea will be fixed and familiarized when the child comes to work his 'times' card using suitable and interesting apparatus. Fig. 14 shows the type of apparatus used for the working of times sums. It consists of a card showing 5 bags drawn in outline and arranged in number-picture formation, a set of small cards of apples, sweets, cherries, or any other suitable objects arranged in number groups, and a sum card.

The number of smaller cards of each group required is indicated in brackets.

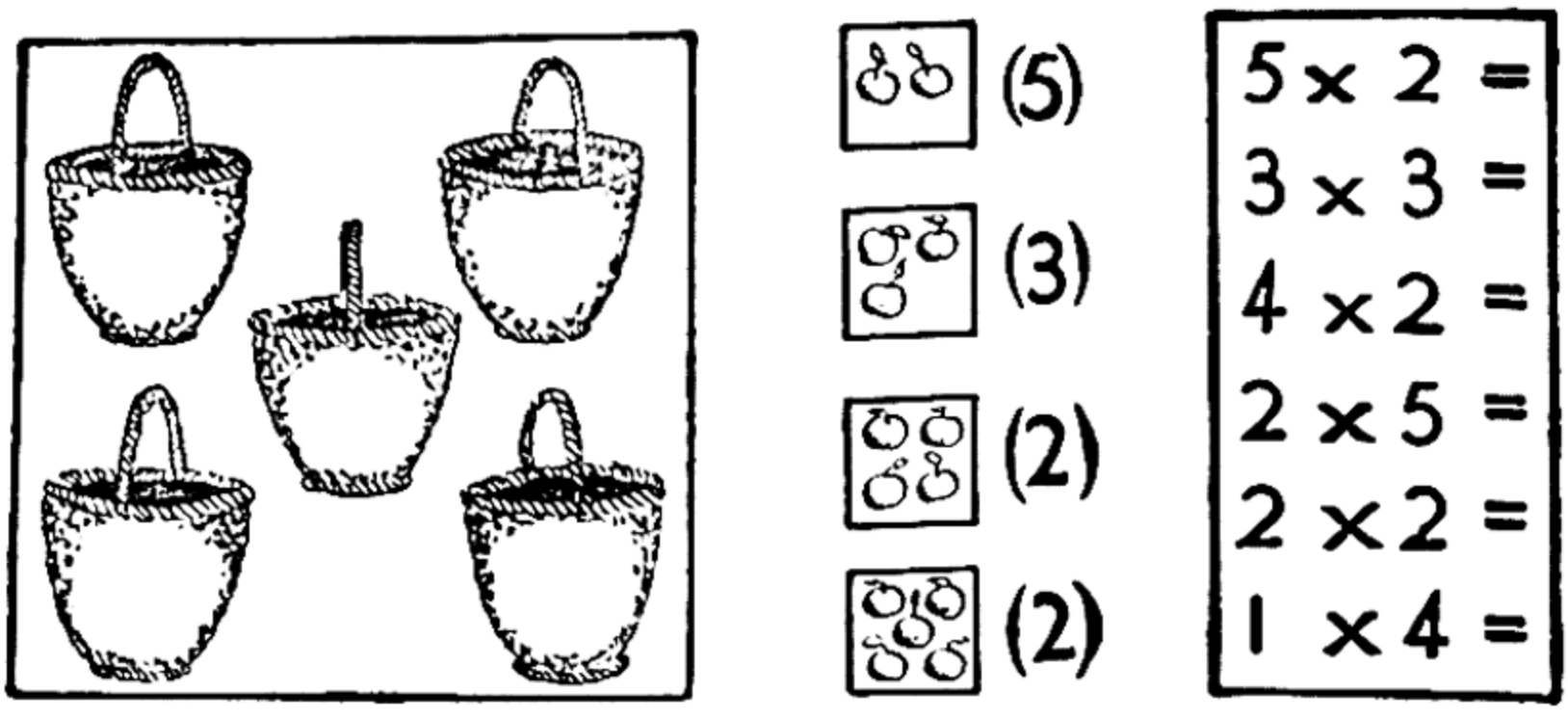


FIG. 14

To work the first sum the child finds 5 tickets showing 2 apples. He then puts 1 ticket in each of the 5 bags, counts the apples in twos, and writes $5 \times 2 = 10$. For 3×3 he will put 3 tickets showing 3 apples into 3 bags, count in threes, and write in his book $3 \times 3 = 9$.

Pictures which may be used by other children in the group are hutches and rabbits, pens and chickens, kennels and puppies, baskets and eggs, plates and cherries, children and sweets, &c. This may perhaps seem an elaborate piece of apparatus; but the response and interest it evokes from the child is well worth the time and trouble spent in the making of it. There is no doubt that visual aids of this kind help the child to form a clear idea of the meaning, working, and application of a rule, and so lay a good foundation of understanding for his future work.

RHYMES FOR COUNTING IN GROUPS

1. 2, 4, 6, 8,
   Mary at the cottage gate,
   Eating cherries off a plate,
   2, 4, 6, 8.
2. 'Count up my eggs', says Mother Hen,
   See, there are 2, 4, 6, 8, 10.

3. Two little chickens
Looking for some more,
Along came another two
And they make four.

Four little chickens
Getting in a fix.
Along came another two
And they make six.

Six little chickens
Perching on a gate.
Along came another two
And they make eight.

Eight little chickens
Run to mother hen.
Along came another two
And they make ten.

(In this game the children play the part of the chickens, and the rest of the class count in twos after each verse.)

4. One little bunny comes hopping,
A clippetty—clippetty—clop.
He hears a sound,
Jumps quickly round,
And puts his long ears up.

(Children count bunny's ears—2.)

Two little bunnies come hopping,

Continue to $5 \times 2 = 10$.

5. Three little boys were chopping up sticks.
Along came another 3, they made 6.
Six little boys were marching in a line.
Along came another 3, they made 9.
Nine little boys going off to delve.
Along came another 3, they made 12.

6. Little ships sailing on the sea,
Sailing together there are 3.
Look! I see another 3,
Three ships, 6 ships on the sea.
Look! I see another 3,
Three, 6, 9 ships on the sea.
Look! I see another 3,
Three, 6, 9, 12 ships on the sea.

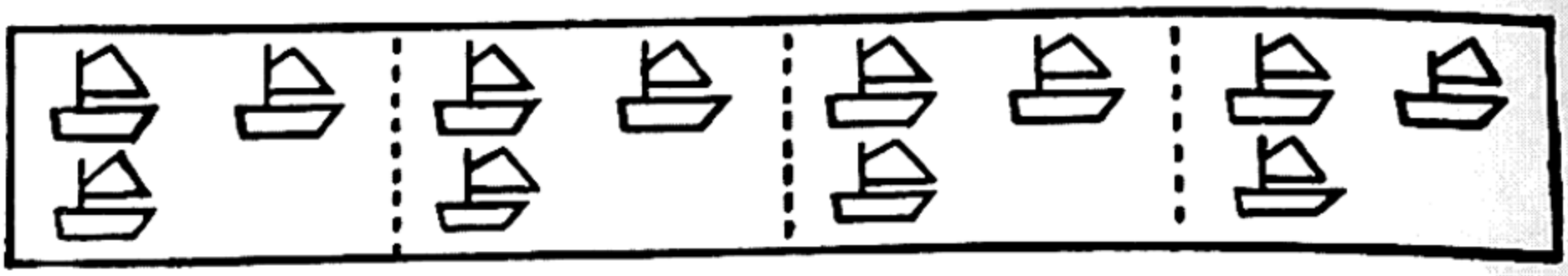


FIG. 15

(For this rhyme, 12 pictures of ships in groups of 3 are mounted on a strip of paper or cardboard. This is moved along from behind a screen as the rhyme is spoken.)

7. Four potatoes for Mary,
Put them on her plate.
Four potatoes for Alan,
Count them now, 4, 8.
Four potatoes for myself,
Altogether 4, 8, 12.

8. One little pussy-cat sits by the tree,
Four little legs has he.
Another little pussy-cat sits there too,
Eight little legs I see.
Mother cat joins them by the tree,
Twelve little legs for pussy-cats 3.

4. DIVISION

Division is without doubt the most difficult of the four rules to teach, and needs very careful introductory work; otherwise children become easily confused. Before beginning to discuss teaching methods it is as well to make clear the fundamental difficulty which the process of division presents to children. A

PRACTICAL EXPERIENCE IN MULTIPLICATION

The 'mothers' are serving potatoes for their family—two for each plate. Then a sum is made to show how many potatoes each 'mother' has taken

A GROUP IS PLAYING SKITTLES, AND MAKING A SUM ABOUT THEIR PLAY

statement 6÷2 may be interpreted in two ways. As expressed to a child in concrete terms it can be either 'If you share 6 apples between Molly and Joan, how many will they each have?' or 'How many twos are there in 6?' In both cases the answer is the same, but a child of 6 or 7 years thinks much more concretely than an adult. An analysis of a child's method of finding an answer to the two questions will show the difference of his thought. In the first case he will take one apple and give it to 'Molly', and another apple and give it to 'Joan', and so on until the six apples are shared, taking up the apples one at a time. In the second case he will arrange the apples in pairs, taking up the apples in twos.

In our experience the frequent confusion of children over the process of division arises because, in the initial stages, these two conflicting methods have been presented at one time. Later, when his mind is sufficiently mature, a child will realize that the two methods represent two aspects of one abstract idea; but in concrete terms, which are the terms in which children under 8 for the most part think, the difference between the two aspects makes them irreconcilable. It is therefore important to decide on one method of working, and to stick to it; for this is a case where the setting up of a right habit should precede the understanding of the process. A little later, when the children are able to grasp, as do adults, the abstract idea of division in its two aspects, explanation will be easy.

Most teachers wish that at a later stage children shall see the statement 6÷2 as the question 'How many twos are there in 6?' The method is the true one, for division is concerned with groups and with subtracting in groups. It is this method of working which is recommended here. By careful introduction and the gradual building up of a habit of working, a bridge can be built between the two aspects of division without leading to confusion.

When a child is first presented with the situation 6÷2—perhaps the sharing of 6 beads between 2 children—the important point is that he shall begin by picking up the beads, not in ones, but in the same groups as there are recipients. He

should pick up two beads and give one to each child, followed by another two and then another two. The method he is using is subtraction by groups, the method he will need for working division sums at a more advanced stage.

Much practical experience of handling actual objects, seeing and noting the results for himself, is essential for the child if he is to master the process of division easily and quickly; such experience can be given without much difficulty. The children work in groups, each group being busy with a different sharing activity. No elaborate apparatus is required, as full use can be made of the normal apparatus of the classroom. At this stage the number of objects to be shared will not exceed 10, and the number of receptacles or recipients will vary from 2 to 5. Putting pencils into boxes, flags in sand-pies, pennies in money-boxes, flowers in vases, balls in baskets, sharing sweets, are some of the many games which can be used to provide practical experience. It is generally wise to put a quick child in charge of each group to ensure that not only is the method of sharing carried out correctly, but what is equally important, that each child takes a turn as sharer. In the meantime the teacher passes from group to group, helping and making suggestions as to what is to be done.

One group may be ready for action with pennies and money-boxes, and a child in this group may be asked to put 8 pennies in 2 money-boxes, so that there is the same number in each.

A child in another group may be given the task of sharing 9 sweets among 3 children in his group. On her next round the teacher will suggest to each group something different to do.

When the children have had some experience in this way, the division sign $\div$ will be introduced. Any of the above activities will do for the purpose. The children will then be shown that sums can be made about their sharing games. The teacher explains that when Betty shares 10 sweets between Bobby and Mary it can be written $10 \div 2$. She then allows Betty to share the sweets (coloured beans) and to complete the sum $10 \div 2 = 5$.

For the next lesson in sharing, any children possessing them are asked to bring toy blackboards and easels to school. Usually a sufficient number turn up to give one to each group.

When the children are ready with their pennies and boxes, or marbles and bags, a few *written* directions in the form of division sums are put on the blackboards by the teacher, e.g. 10÷2, 6÷3, 8÷4. Each child in the group takes a turn at working one or more with the apparatus provided and puts the answer on the blackboard.

Apparatus for Division

When once the teacher is satisfied that the method of working is understood, the children are given individual practice cards to work, but still encouraged to use concrete material. A child is given a card of division sums and a card of five outline drawings of baskets, kennels, bags, &c., as used for multiplication, into which he can put his smaller single pictures of eggs, puppies, or marbles. (Fig. 16.)

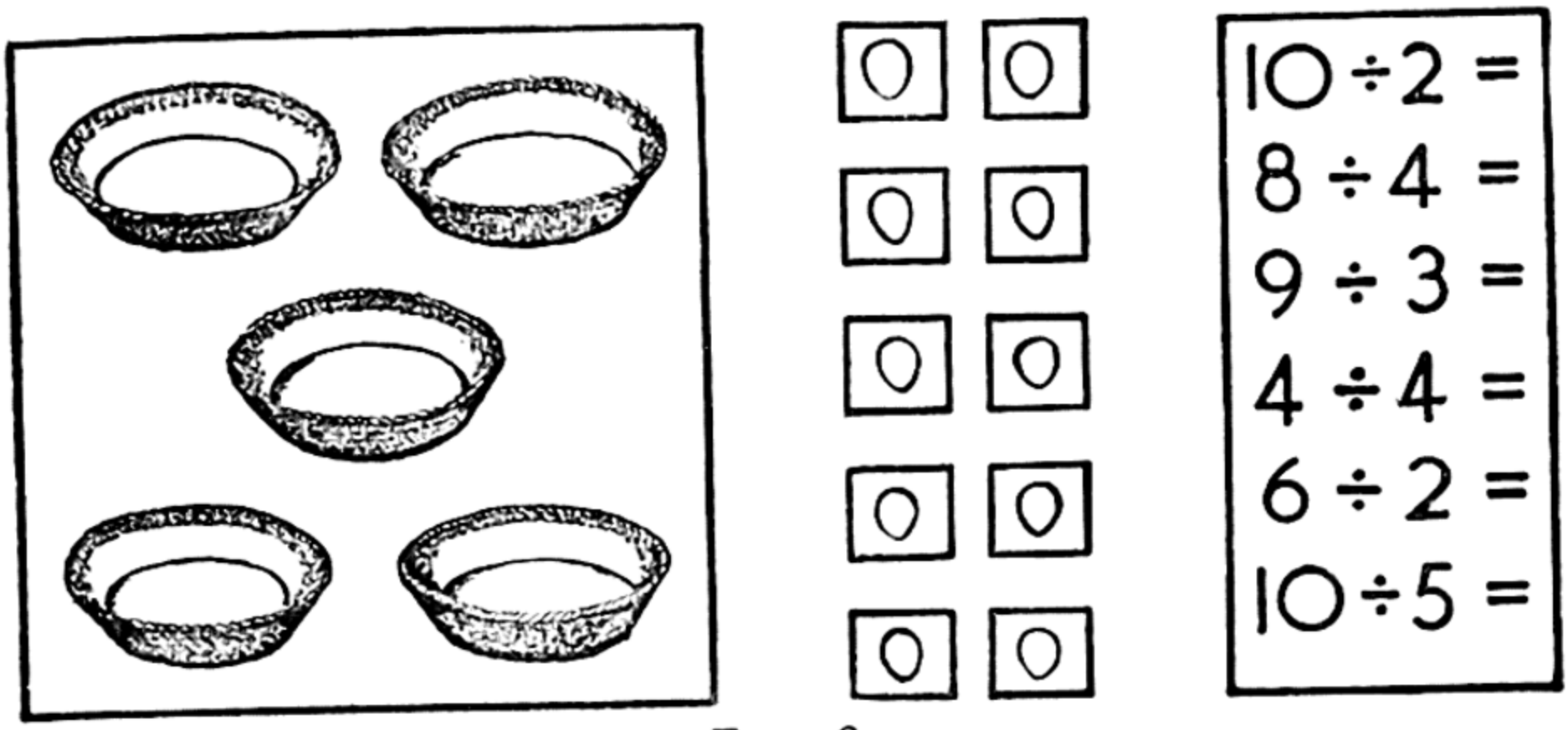
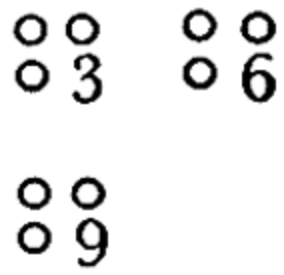


Fig. 16

To work 10÷2, the child finds 10 eggs and puts them into groups of 2, setting them out on his desk in number-picture formation. He shares them out into 2 baskets on his card, keeping to the method he has been taught, and writes in his book 10÷2 = 5.

This method of arranging the groups in number-picture formation helps the child at a later stage when he comes to work without apparatus. Take, for instance, the sum 9÷3, which he will read later as 'How many 3's in 9?' To find out,

he must count in 3's as far as 9. As a result of his earlier experiences his mental picture will be  and he thus realizes that 3 groups of 3 can be made out of 9.

When the first stages of multiplication and division are mastered, then the children are ready to work practice cards with numbers, first to 10 and then to 12.

This chapter has dealt solely with work involving numbers up to 12, thought of simply as numbers. At the same time, however, as these activities are taking place, the children are beginning to make their first experiences in shopping and in using money. Such experiences are dealt with fully in Chapter VI.

IV

PRACTICE CARDS AND GAMES WITHOUT APPARATUS

MANY teachers are concerned as to when children should be asked to work their sums without the assistance of apparatus. They fear that the children will get to depend on the apparatus instead of on their own mental efforts. Naturally because of the inequality of ability in children, this break from apparatus cannot take place at any fixed time. To begin too early is to defeat one's own purpose. It is possible, of course, to obtain a mechanical response, but in few cases is this based on a proper understanding of the situation involved. It has been found a sensible and workable plan to allow each child, regardless of ability, to work through the entire practical scheme on number to twelve before he is encouraged to discard apparatus. Most teachers will agree that it is far easier and more within the scope of a six-year-old to work division, for instance, with apparatus than subtraction without. Time spent in this way often proves in the long run to be time gained. The child who with the help of apparatus can work the four fundamental rules to 12 without confusion, has taken a good step forward

in the mastery of number. He can then be introduced to the possibility of doing sums without visual and concrete aids. With a quick child the break is often complete. To his slower companion the process may be gradual; and so his apparatus ought to be by him for him to use if he finds himself in need of it. In any case it is usually the child who makes the break, because he finds the apparatus more hindrance than help. But even when apparatus has been discarded because the child knows the number bonds, it should still be available if needed at any time.

As children vary enormously in the speed with which they progress, it is very important to have plenty of suitable activities at hand to keep the quicker children busy, to give them plenty of practice in speed and accuracy, and to stretch them to the limits of their capacity. One of the most likely causes of disorder in a classroom is a group of children with too little to do. When the children are beginning to give up the use of apparatus, some of them will begin to work through sums very quickly. So it is necessary to have a lot of suitable number cards in readiness. The working of practice cards has a definite value for the child in another sense. As he works through a graded series of cards, he realizes and is pleased with his own achievement: he feels he is making progress and growing up.

Number games also play their part in providing the right kind of interest necessary at this stage to develop and quicken the child's number responses and alertness. A few are given below. For most of them the children play in pairs. Each child has two turns, adds his sums mentally, and writes down the total.

1. *Spinning-top.* This is made from strong cardboard and marked with numbers 0 to 5. Half a kindergarten stick is sharpened to a point and put through the centre.

FIG. 17

The child spins the top. When it stops, one side is on the table, and the child writes down the number printed on that side. He spins the top again, writes down another number, and then adds his sum.

2. *Rolling balls through arches.* The arches are cut out of the side of a large boot-box. This prevents the marbles rolling in all directions. Either two marbles can be used or the child has two turns.

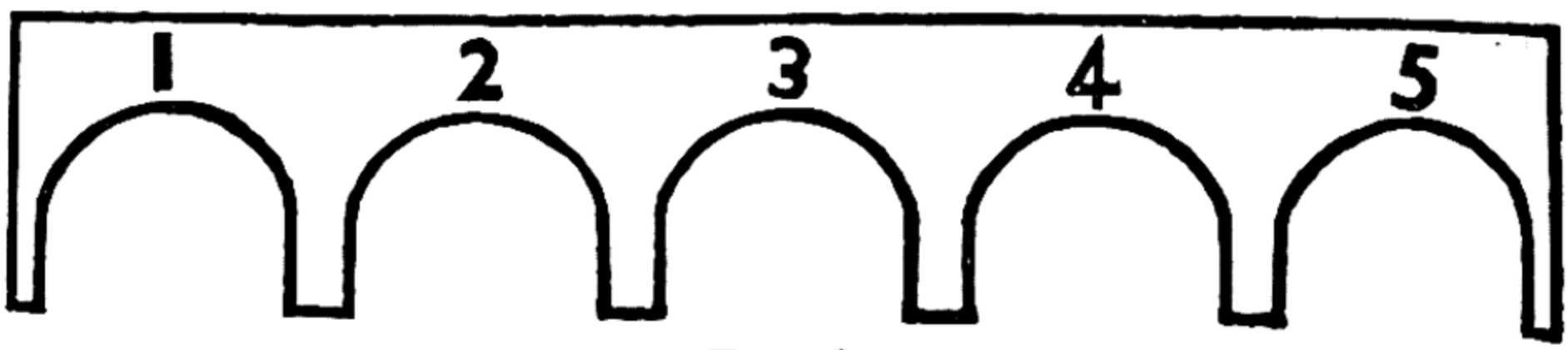


FIG. 18

3. *Skittles.* After his first shot the child makes a mental note of the number he knocked down before setting up the 9 again for his next try.

4. *Fishing game.* This is played in the usual way with a magnet fastened to the fishing-rod. Each fish bears a number—any number from 1 to 5.

5. *Throwing the wet sponge.* The blackboard, which is marked into squares containing figures 1 to 5, is used as the target.

6. *Dominoes.* The first set deals only with addition and subtraction to 10. Later other rules are included.

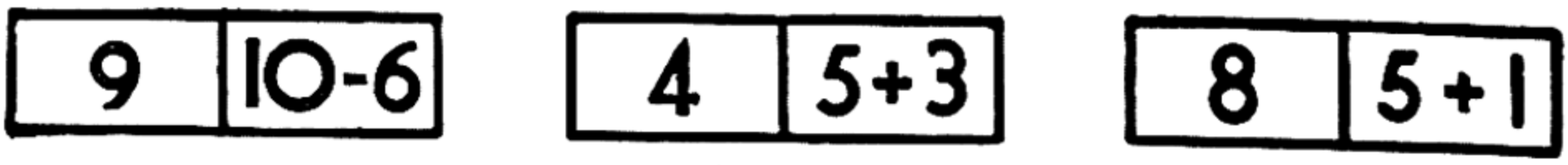


FIG. 19

7. *Bus rides.* The children go for a ride in a bus made from chairs and pay for their own tickets. The length of ride is determined by the price paid, the conductor calling 1*d.* stop, 2*d.* stop, &c. For this game it is necessary to have differently coloured tickets for each price. Tickets are fastened to a piece of cardboard by elastic, threaded through holes. They can then be easily taken out and put back again. Coins necessitating the giving of change may be offered. For instance, a child may offer 6*d.* for a 2*d.* fare. He can, if he wishes, pay for himself and a friend. (Fig. 20.)

Children are always willing to bring bus-tickets when asked; but if a really good collection is needed quickly, it is usually possible to get a large bag of used tickets from the local bus

garage. It is better to collect local tickets as these are the ones the children and their parents use and therefore have a 'real life' meaning and value to the children.

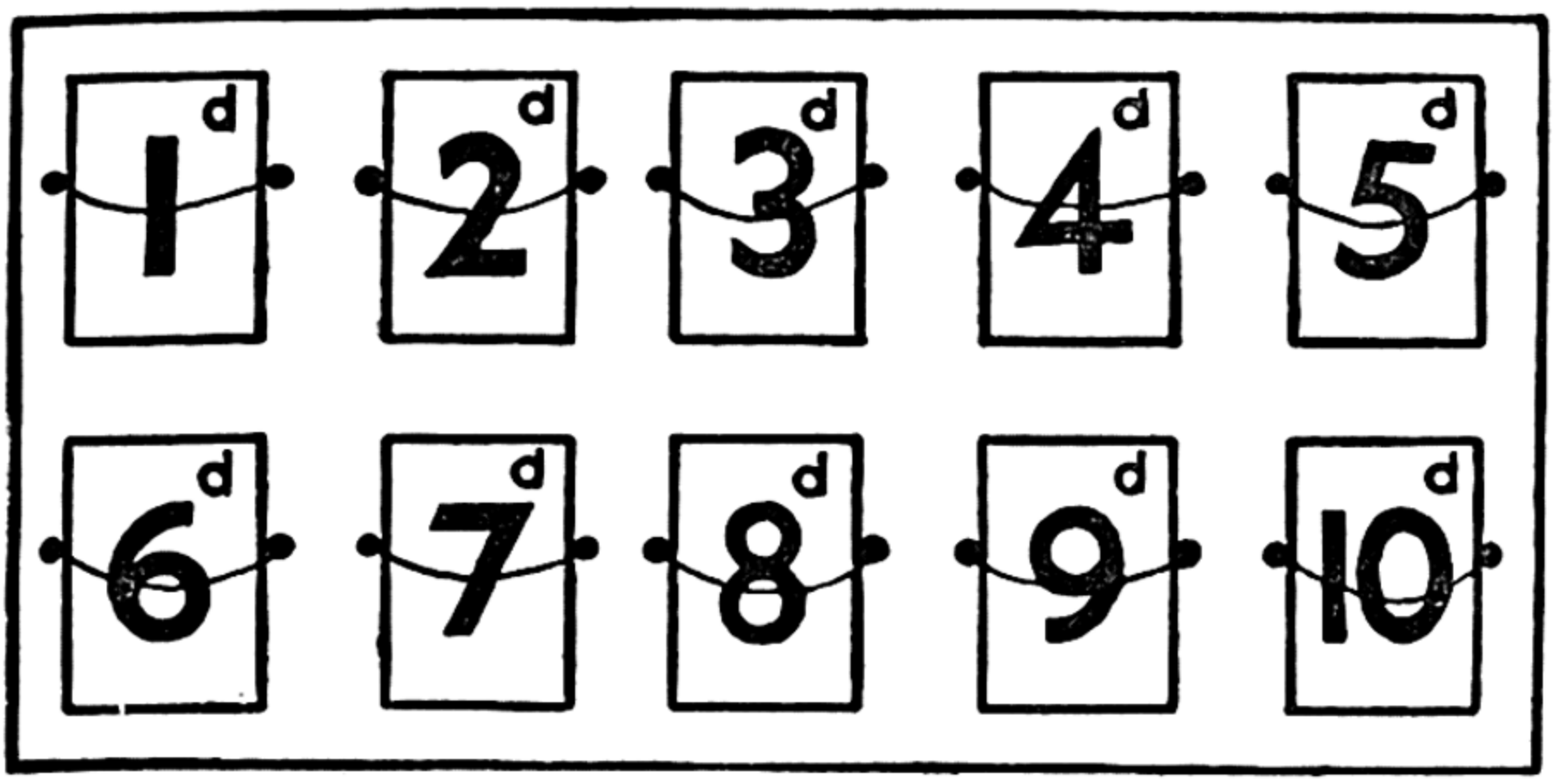


FIG. 20

V

PRACTICAL AND WRITTEN WORK ON NUMBER UP TO 20 AND 24

THE position of this chapter may be rather misleading. In actual practice, work with numbers up to 20 does not immediately follow after the first experiences in the four rules with numbers up to 10 and 12. The chapters are so arranged for the sake of convenience and clarity. What does actually happen in the classroom is that the children at different times, on different days, are busy about a variety of activities, shopping, measuring, playing number games, and working simple sums. When a child has learnt the working of a rule—for example, how to build up simple addition equations—he will use his ability for making little bills for his purchases at the classroom shops or in measuring or weighing activities. The kind of activities which take place in shopping, measuring, and weighing are described in Chapter VI; and the reader is advised to

look at that chapter, and also at the scheme of work set out in Chapter VIII, and consider them in relation to this chapter.

The aim underlying all the methods and activities described in this chapter is to help children to gain a thorough knowledge of number facts up to 20 and then to 24, so that their responses become automatic. Teachers of a generation ago appreciated the importance of this mastery, although by their mechanical teaching methods they did not by any means always achieve their end. It is tedious to children to be faced day after day with the prospect of working complicated sums, when many of the number bonds have to be counted every time they occur, and one cannot wonder that many children become tired, bored, and finally discouraged. Many ways in which children can be helped to achieve mastery of the number facts of 20 or 24 are described in this chapter and the next. Time, patience, repetition, ample practice, and above all variety of experience are all factors which contribute to the learning of the basic number facts.

1. ADDITION

When the teacher is quite sure that a child has a thorough knowledge and intelligent understanding of numbers up to 12, then the extension of work with numbers up to 20 and 24 can safely be tackled. First, however, the child must be able to count and write numbers up to 20. Otherwise he will be found writing 21 for 12, 51 for 15. He will also need to know the meaning of 'teen'—to be shown how to build up each number, using counters, sticks, or beads, and to write out the list of equations thus made, $10+4=14$, $10+6=16$, &c. A box of loose sticks and rubber bands are very helpful for this purpose, for with these a child is able to build up a bundle of 10 sticks, which, when held together by a rubber band, gives him a true idea of 10 considered as an entity. Fig. 21 illustrates a very useful piece of apparatus. It consists of a strip of cardboard, on which are pasted 10 disks of one colour, 9 smaller strips graduated in size, bearing 1, 2, 3, 4, 5, 6, 7, 8, 9 disks respectively, and a card giving number equations to 19.

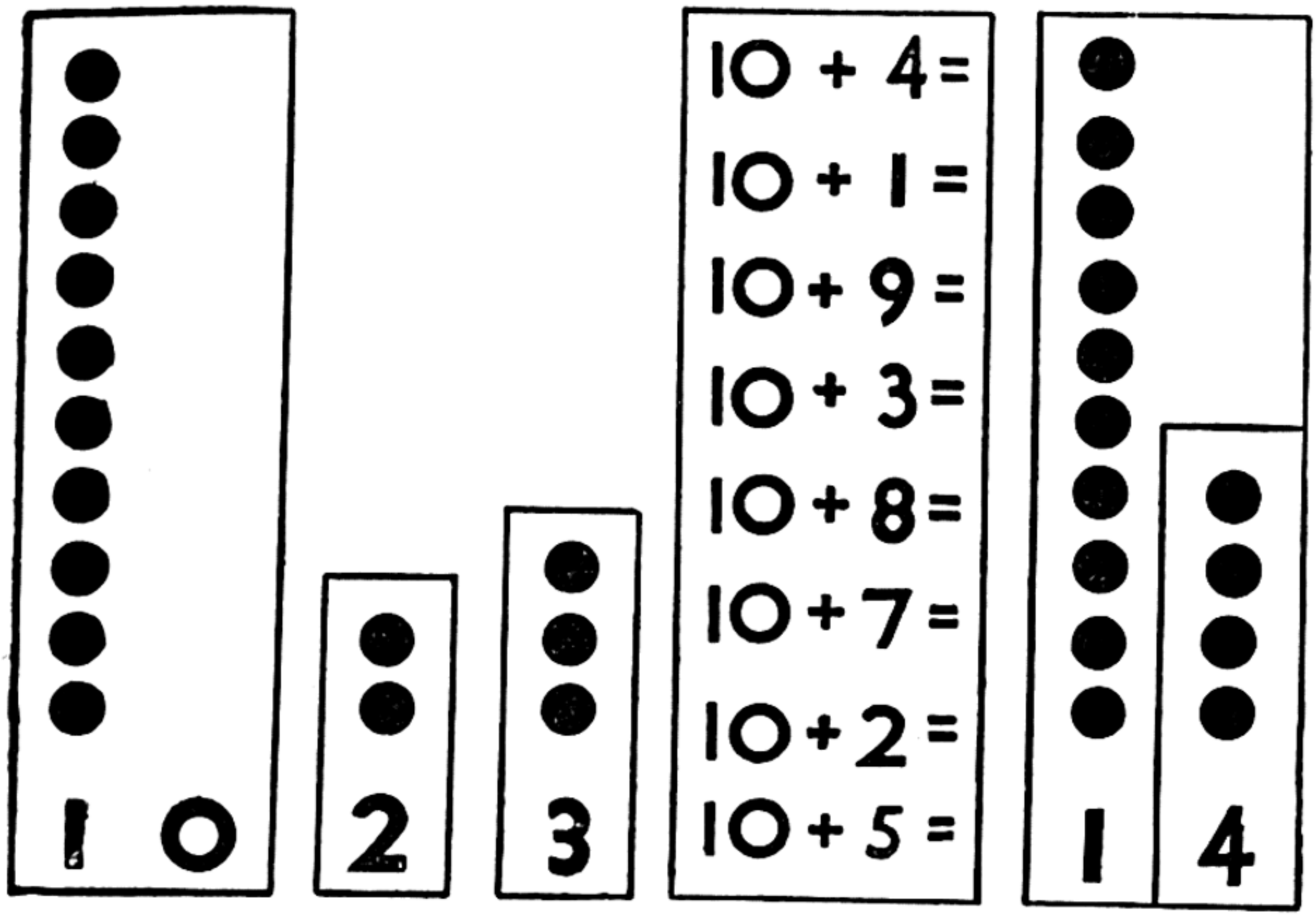


FIG. 21

To work 10+4 the child finds the 10 strip and the 4 strip, and by putting the 4 strip by the 10 strip so that the 4 covers the 0 of the 10, he discovers the figure 14. When these equations are understood and known, the child can work addition sums dealing with all number combinations up to 20. At this stage he sets them down in column form. He uses the same process as he did when dealing with addition of numbers to 12, that is, he decides which is the greater number and counts on the rest. This is not likely to lead to inaccuracy if he keeps in mind the number picture of the figure he is adding. Thus in dealing with $\begin{array}{r} 5 \\ +8 \\ \hline 13 \end{array}$ he will interpret it as

9 10

13

11 12

8

If, however, he has difficulty in visualizing such a pattern, he will use concrete material to discover his answer. His next step is to work out and memorize six addition facts, namely,

$5+5=10$, $6+6=12$, $7+7=14$, $8+8=16$, $9+9=18$, $10+10=20$. When these are known, he can be encouraged to use them in order to take a short cut when he has to add two numbers of almost equal value. For instance, he will be shown that, since he already knows that $8+8=16$, he can deduce that $8+7$ will be 1 less and $8+9$ will be 1 more than 16. Such devices as this—as the use of visual pattern suggested above and of concrete apparatus for counting—are merely intermediary props which the child will no longer need when the bonds of 20 are thoroughly known. It is the teacher's job to see that the child is helped both to make use of these props and to discard them when they are no longer needed. Much practice is needed in addition, both in working sums and in mental drill, before the child knows all the number facts to 20 so well that calculation has become automatic. If this is to be successful there must be variety of activities.

2. SUBTRACTION

Generally speaking, subtraction is considered by most teachers a hard rule for children to grasp. This is quite true of the mental operation of subtraction to 12 if the groundwork has not been well prepared through concrete experience. On the other hand, subtraction to 20 can be a fairly easy matter, particularly to the child who can perform with quickness and accuracy the operation of addition to 20. One rule is but the inverse of the other, and there is no reason why at this stage the two processes should not be taught side by side. If, for instance, the child has learnt as an addition fact that $7+8=15$, then he should know also that 7 requires 8 to make 15 or that $15-8=7$. But some children are much slower than others in memorizing number facts. If their progress is held up because of their inability to memorize, they may grow wearied and discouraged. They are better employed in getting further number experience through number games, shopping activities, &c. The practice they get through these activities will in course of time make them familiar with those number facts so essential for further progress.

3. MULTIPLICATION

The first step is to extend the counting in groups from 2 to 10 as far as 20. Children always enjoy saying and acting counting rhymes, therefore a few which have been found useful are given at the end of this section. Large coloured pictures which show a lot of detail can be used for group counting. A picture of a busy street will produce plenty of twos, such as pairs of shoes or legs, to count, and the wheels of vehicles will provide plenty of fours. School milk-bottles, referred to earlier, in baskets of thirty-five, present an ideal counting medium for fives. There are also plenty of classroom games and activities which can be devised by an inventive teacher. For other activities the children build up and draw the groups, putting the appropriate multiplication sum, as they did in the earlier stage to 12. A child's work with threes will appear thus:

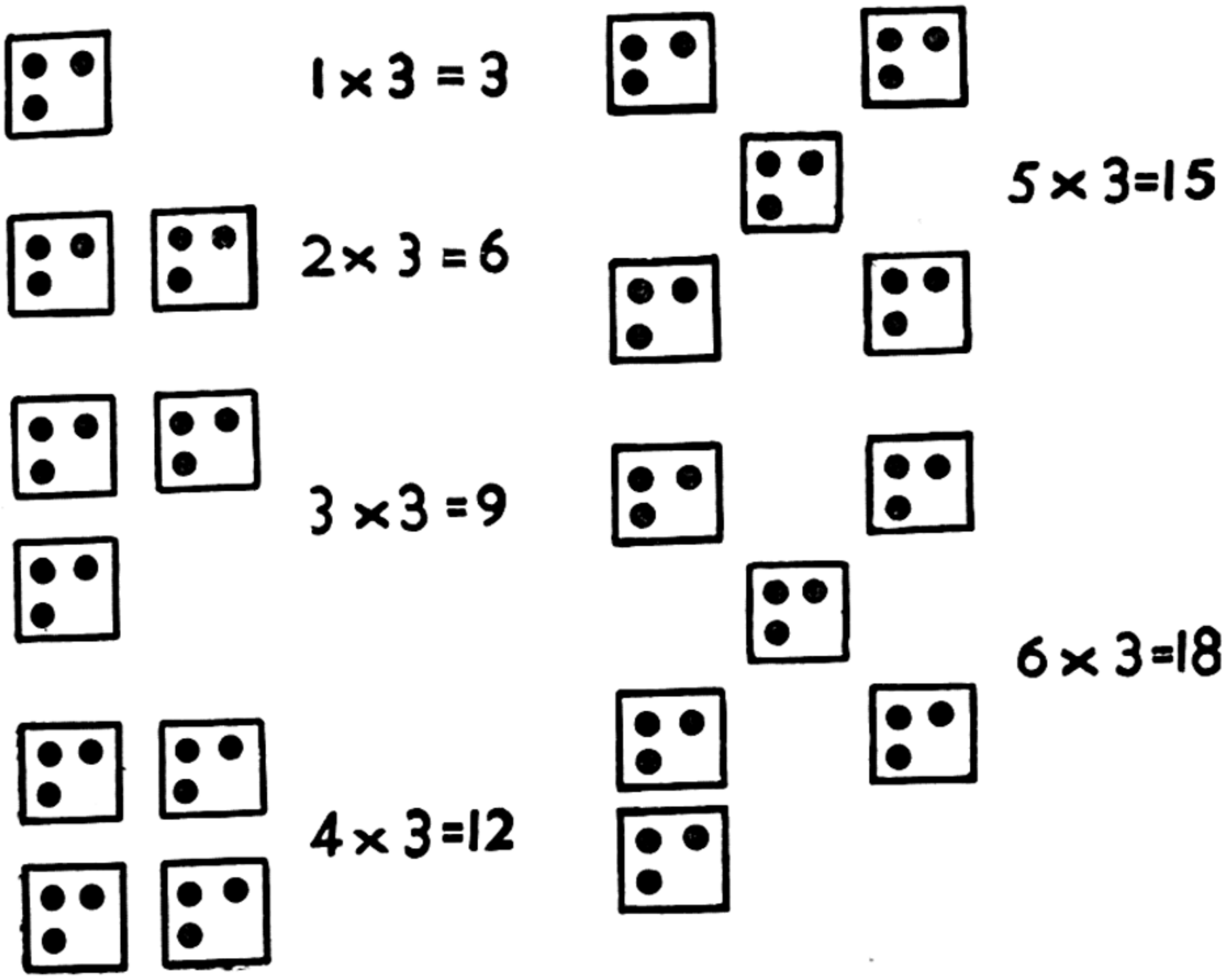


FIG. 22

Several lessons will have to be spent in this way during which the child not only learns to count in groups but discovers, through practical experience and the use of concrete material, that more than one set of factors can belong to the same whole number. He learns, for instance, that 16 can be set out as 8 groups of 2, 4 groups of 4, or 2 groups of 8.

For the next stage the child works a practice card giving the factors of numbers up to 20, $4 \times 4 =$, $6 \times 2 =$, $5 \times 3 =$, &c. If he has thoroughly memorized counting in groups of 2 to 10, as far as 20 he can make use of this knowledge in working his sums without using apparatus. Suppose, for instance, he is working 6×3. To tell him to count in threes 6 times is not sufficient. Most likely he will stop short of, or go past, 18. He is therefore encouraged at this stage to tap out on his desk the number picture 6 while he counts in threes, and to stop at the number which completes the picture.

3 6

15

9 12

18

The child who takes longer to memorize group counting will need apparatus to work his practice card. He is given a packet of tickets with small coloured disks arranged in groups. In order to save time in sorting these, one colour is used for each number group, blue for twos, green for threes, red for fours, &c. The child sets out the number of tickets as directed in the sum. For 5×3 he finds 5 tickets having groups of 3, sets them out in number-picture formation, counts in threes, and writes $5 \times 3 = 15$.

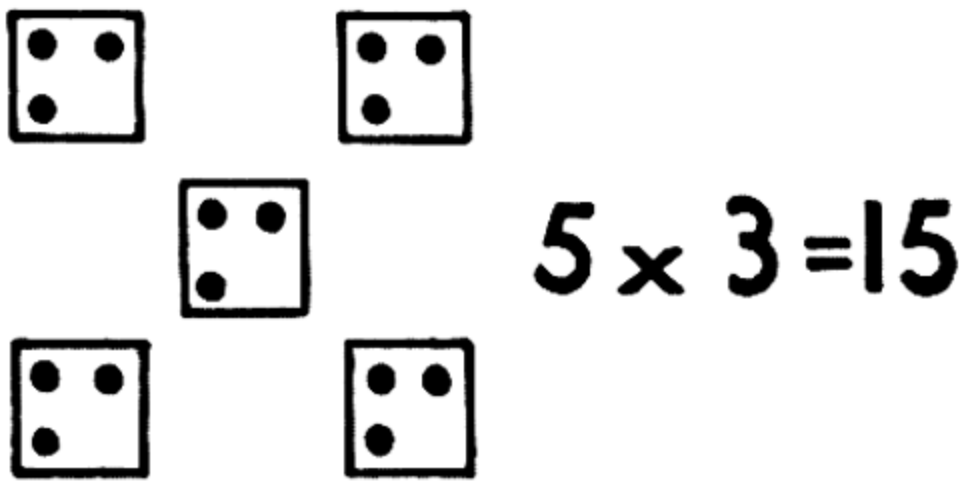


FIG. 23

The teacher watches to see that, from the beginning, he counts in threes and not in ones.

Much practice in working multiplication sums is necessary before calculation becomes automatic; but unless it is given, the child will be handicapped when he comes to deal with division. Games also should be used to encourage speed and accuracy. Some of those given at the end of this chapter can be adapted for use with multiplication. Number snap is a particularly good one. A child soon realizes that he must concentrate and think quickly in order to be the first to call 'Snap' when he turns up a card such as 4×4 while his opponent has 8×2. When introducing the game it is as well to take factors of not more than two numbers, say, of 14 and 16 or 16 and 20. Others can be included later to give the child practice in dealing with factors of all numbers to 20.

Most teachers will agree, however, that some children learn multiplication facts much more easily and more quickly if these are arranged in numerical order, that is, in table form. Just as children love the rhythm and lilt of 2, 4, 6, 8, the sound of $1 \times 2 = 2$, $2 \times 2 = 4$, &c., makes a similar appeal. There is no reason, then, why the child should not be introduced to the idea of building and learning a table before he leaves the infant school. He begins by sorting out all the multiplication facts concerned with twos, and putting them in numerical order, beginning with $1 \times 2 = 2$. Then he deals with threes, fours, &c., up to tens. Having built up his tables to 20, it is but a short step to 24; so it is probably better to make this number his last halting-place in multiplication; otherwise he will be held up when he comes to deal with multiplication in money to 2/-.

Rhymes for Group Counting

1. 2, 4, 6,
   8, 10, 12,
   For potatoes dig and delve.
   14, 16,
   18, 20,
   Fill my basket, 'twill be plenty.

2. *The Noah's Ark*
Just before it gets quite dark,
The animals walk into the ark.
Two pigs, two cows, a cock, a hen,
Two ducks, two horses, they make ten;
Two dogs make twelve, two sheep fourteen.
This is the funniest sight I've seen.
Two giraffes, two kangaroos.
Sixteen, eighteen, all in twos!
Come along—of room there's plenty.
Two big elephants—they make twenty.

3. 3, 6, 9,
Children in a line.
12, 15, 18,
All friends a-waiting.

4. A chair for Mother, a chair for Dad,
A chair for John and Jean.
Count the legs on all the chairs,
4, 8, 12, 16,
A little chair for Baby Ben.
Twenty legs on five chairs then.

5. Mr. Brown is selling sticks,
All tied up in bundles of six.
Three large bundles on his stall,
Six, twelve, eighteen sticks in all.

4. DIVISION

From his earlier lessons the child has learnt to realize that the answer to a division sum can be found by calculating the number of smaller quantities contained in the larger. With this important and essential clue to help him, as well as a sound knowledge of multiplication facts, division within the limits of 20 should not be too difficult. Take, for instance, the sum $15 \div 3$, which he will interpret as 'How many threes in 15?' If he knows $5 \times 3 = 15$ as a multiplication fact, he should be able to supply the answer readily, $15 \div 3 = 5$. If his memory fails him, he counts in threes to 15 and, just as he did

in multiplication, he taps out a number picture on the desk whilst doing so. He finds he has tapped out picture 5 when he gets to 15, and with this clue to help him he completes his sum $15 \div 3 = 5$.

5. NUMBER GAMES

Before leaving the infant school it is useful that the child should not only understand the fundamental ideas of number, but should have acquired speed and accuracy of calculation in manipulating small numbers. No set rules can be laid down for securing this: much will depend upon the ingenuity of the teacher in devising the right kind of activity to give the children enough practice without wearying them. Number games of the type suggested here can be very useful at this stage. They help to encourage a concentration of mental energy upon the task in hand, and this is the first requirement for rapid and accurate thinking.

1. *Number snap.* The game is played in the usual way, in pairs or by a small group; but instead of pictures the cards show number combinations to 20, including the four rules. A child turns up a card, say, $\boxed{7 \times 2}$. Another may turn up $\boxed{16-2}$ and another $\boxed{8+6}$. The child who is first to call 'Snap' is the winner.

2. *Dogs and bone.* The children sit in a half-circle, each holding a card showing any number to 20. These are the answer cards, and there should be two of each number. The teacher or leader places on the floor in the centre of the ring a sum card, the answer to which is on two cards held by the children. For instance, if the number combination shown is $\boxed{3 \times 5}$ then two children each hold 15. The first of these to run out and pick up the 'bone' is the winner.

3. *Two team games.*

(*a*) The children line up in front of the teacher in two teams. A sum is asked of the leaders, and the one who is first to give the correct answer goes to the end of his line, and his place is taken by the second child. Another question is given, and thus the game proceeds until one of the original team leaders

arrives back at the head of his line. This team is then declared the winner.

(*b*) This is a game for four teams. Several large cards, each marked with a number not exceeding 20, are placed about the room. These show the answers to a set of sum cards, one sum on each card, with which the game is played. The cards are put face downwards on the floor in the middle of the room. The children run round in a circle, either to music or without, and at a given signal they stop, pick up a card, work the sum, and run to the home containing the answer. If, for instance, 9+6 is the card picked up, the child will run to the answer card marked 15. The first to match his card to the correct answer is awarded a point for his team. The cards, except the winner's card, are collected up again, and the game continues until there are no cards left on the floor. It is obvious that for this game there must be several cards resulting in the same answer, e.g. 15 may be 9+6 20−5 3×5 7+8.

4. *Stepping-stones.* This is a game played in twos, whilst the rest of the group watch to see if calculations are made correctly. Each child sets off to cross the river. In the place of stepping-stones are cards containing sums. The stepping-stones, showing the answers to the sums, are placed down the centre between the two sets of cards.

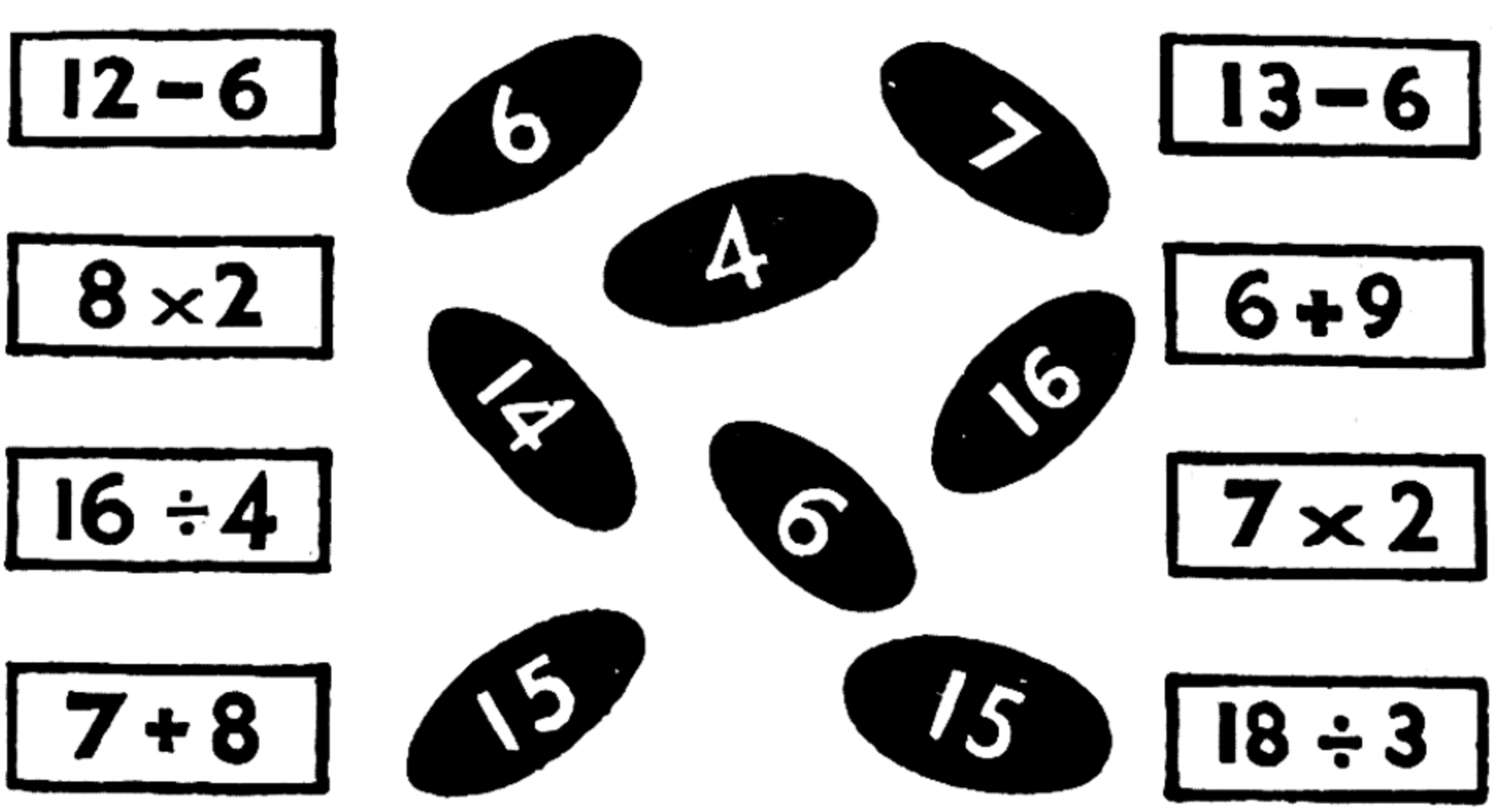
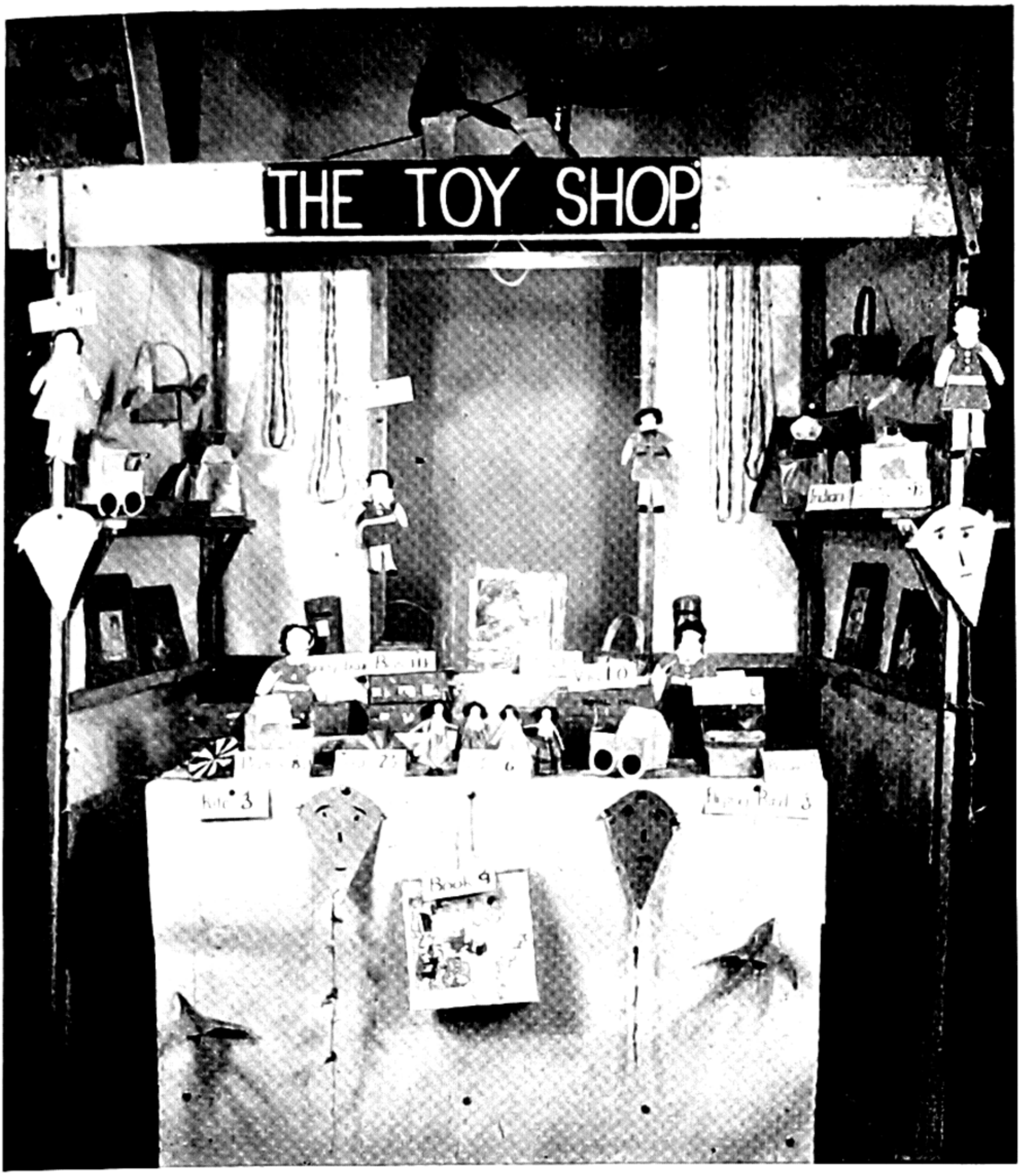


FIG. 24



THE TOY SHOP

The wooden framework described on page 85 is in use. The making of the toys is described in Chap. IX

A CUSTOMER COMES TO THE SHOP

The price-list is a guide to the shopkeeper and enables the rest of the group to check his calculations

The child works the first sum, finds the answer on a stepping-stone, which he then places on top of the sum card. When, as a result of working all the sum cards correctly, his stepping-stones are in position, he crosses the river. The first to do so is the winner. For the next two players a different set of cards is used.

VI

MEASUREMENTS AND SHOPPING

SOME of the first contacts a child has with number are through various types of measurement. From babyhood he has gone shopping with his mother and has heard her ask for a *pound* of biscuits, a *yard* of ribbon, a *pint* of milk, and has seen her measure the value of these things in money. He knows, too, something about the measures of time. When he is called in the morning his mother says, 'It is eight o'clock, time to get up'; in the afternoon he is told, 'Daddy won't be long now, it is nearly half-past five'; and later in the evening he is told to put away his toys because it is 'Bedtime, seven o'clock'. Much of children's spontaneous play centres round domestic activities of which shopping is nearly always a part. It seems, therefore, only reasonable that, when the child comes to school, our methods of number teaching should start from his own experience, that we should use his spontaneous impulse to play out the actions of the adult world, that we should enrich them by our own greater experience, and so ultimately fit the child to be able to deal successfully with the actual situations of adult life. It may be well at this point to remind ourselves of the use the majority of people make of their knowledge of number. Most people use arithmetic in their ordinary lives for handling their money—largely for shopping; for weighing and measuring and making simple calculations with the results of their practical activities; and for dealing with the small fractions which occur in everyday life. With most of these activities a child is probably familiar when he enters school,

and he has a great incentive to learn more about them, since children are interested in the adult world and long to grow into it and to be able to master its intricacies. If a small child is able to carry through a purchase in a shop and check his change, he gets a sense of achievement which is a real contribution to his growth of confidence and capacity for effort.

Shopping activities in the number period open up a great many other possibilities. The first step is for teacher and children to decide together what shops they would like to have. Then they must find out what goods should be in the shops and how these can be made. Naturally the actual making of the shop goods will be done in handwork times. In Chapter IX there is a description of some simple ways of making shops which teachers and children have worked out together and found successful.

The set-up of a shop for the first shopping lessons should be very simple. For instance, a few boxes of coloured beads, jars of dyed beans, and a pair of home-made scales will fit up the sweet shop, while the draper's shop has for its sole commodity lengths of lace or ribbon (paper). With a few essentials added to the existing stock, and a necessary adjustment of prices, these simple shops can also be used throughout the infant school. For more advanced work the following can be added to the shop: a few lengths of materials (wallpaper), cards of buttons for dozens and half-dozens, pairs of socks and gloves, all of which can be made in handwork times. A tape-measure or yard-stick is another necessity. The stock of the toy shop can be increased from the school toy-box. Real scales with weights will become essential for the sweet shop, also extra jars of 'home-made' sweets. For variety the children can model potatoes, carrots, and other vegetables in handwork lessons and so gain experience in buying and selling at the greengrocer's shop. At the milk-bar there will be needed half-pint, pint, and quart measures and an increased supply of 'milk' and 'fruit drinks'. With careful planning it is possible for each child to obtain a very satisfactory amount of concrete experience appropriate to his age, in shopping, weighing, and measuring, from these very simple shops.

It is time to begin work with measuring activities when the children have been attending school long enough to understand and carry out simple directions given by the teacher, and have a knowledge of numbers to 6. It is probably wise to introduce the use of each shop at the beginning by a class demonstration. Then the children are put into about four groups—if possible with one or two children of initiative and intelligence as leaders of each group—and each group is put in charge of one shop. On one day per week shopping is the main feature of the number lesson. Thus by the end of four weeks each group has had a certain amount of practical experience in money, weighing, measuring, and capacity. The shopping activities are, of course, carefully graded, as are also the practice cards which give the children exercises to do leading up to, or resulting from, their shopping experiences. These cards are important as they help to fix the number facts learnt during the shopping.

	NAMES	MONEY	LENGTH	WEIGHT	CAPACITY
		Money to 10½ Buying two toys from toy shop	Measuring lines in inches & half inches	Buying one to three ounces of sweets	Filling large measure with smaller
GROUP A	Pat David Derick Anne Joan	Oct.3rd	Oct.10th	Oct.17th	Oct.24th
GROUP B	John etc	Oct.24th	Oct.3rd	Oct.10th	Oct.17th
GROUP C	Mary etc	Oct.17th	Oct.24th	Oct.3rd	Oct.10th
GROUP D	Peter etc	Oct.10th	Oct.17th	Oct.24th	Oct.3rd

FIG. 25

Unless the teacher keeps careful records of the individual children's activities, so that she is able to check up on their progress, there is a danger that these shopping lessons, although enjoyed by the children, may not achieve their aim. The record can be quite a straightforward matter if arranged in the form of a table. The groups and names of children in each group are written on the left-hand side and the graded steps of the activities along the top. The date only of the activity is entered. (See Fig. 25.)

Each child has a shopping-book in which to record his activities. A picture appropriate to the work, a pair of scales, a clock, a milk-jug, &c., can be pasted on the cover to add to its attractiveness and to enable the child to distinguish it from the rest of his books. The following suggestions are intended only as general outlines for lessons dealing with forms of measurement. They can be supplemented by talks in which suitable pictures can play a part. Such pictures as 'The Milkman', 'The Clockmaker's Shop', 'At the Toy Shop', will interest the children and encourage them to talk about their own experiences.

1. MONEY

One of the frequent criticisms of shopping activities is that the children do not really use money correctly in shopping. This criticism is usually made because teachers are not themselves clear about the difference between directed shopping activities which are a part of number work and free shopping play. Both are necessary, but to allow children only the former is to deprive them of a very necessary form of imaginative play, while to expect them to learn about money values only through the latter is foolish. If they are having carefully directed shopping activities, children will incorporate some of the money transactions into their free play which will become the richer by their increased knowledge. A graded series of directed shopping activities with suggestions for practice work is set out in detail in the next few pages. Each teacher will probably approach this work in a rather different way. Some may like to work out the development of the use of money in shopping

differently every time they teach it. But if these lessons are to be successful, the teacher must have a clear realization of the difficulties and a clear plan in her mind.

Before starting to give details of the graded scheme, a word might be said about organization. There are many ways of arranging shopping activities; but apart from occasional class demonstrations, lessons where one child or a very few children are active and the rest spectators are not suitable. While actual shopping goes on, there ought to be some subsidiary activity to occupy the children who are not having their turn. If children are not busy they will undoubtedly become restless.

Preparatory Activities

In early free shopping play, a time will come when children begin to give money in exchange for what they buy. Most children will have reached this stage by the time they come to school, and will be ready to use cardboard coins in shopping play; but a new group who have not begun to play at giving money should be watched, so that the teacher can take advantage of the moment when the group begins to be interested in coins.

Very soon the children will be ready to make and use price tickets. As they will still be at the stage of counting and recognizing numbers, a good supply of cardboard pennies and some home-made purses will be needed. At first goods should be priced up to 6*d.* only.

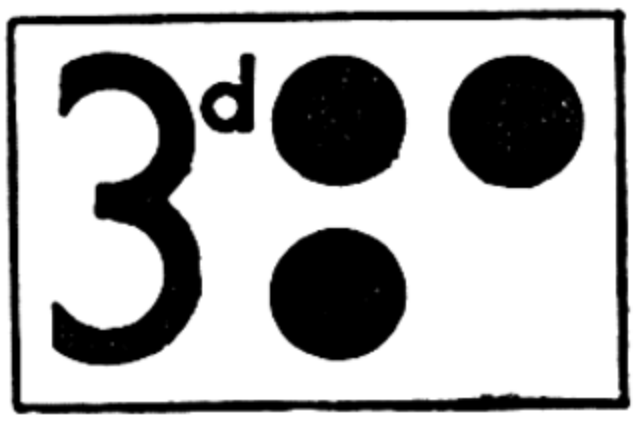


Fig. 26

Certain directed shopping activities can be developed from the free play; for example:

a. Each child in a group buys a toy and draws a picture of it before buying another. At this stage the price is not written.

b. The children practise writing prices and drawing the right numbers of pennies.

Fig. 27

They can now write the prices of the goods they buy and draw. At this later stage it may sometimes be a good plan to give each child in the group the same sum to spend, for instance, 10*d*. At the end of his shopping, his drawings together with his change (if any) should total to 10*d*. The teacher can thus quickly tell whether each child is shopping correctly.

Recognition of coins with their value is first learnt in shopping play where new coins are added gradually to the class purses. Two pieces of apparatus give practice in the recognition and value of coins. (Fig. 28.)

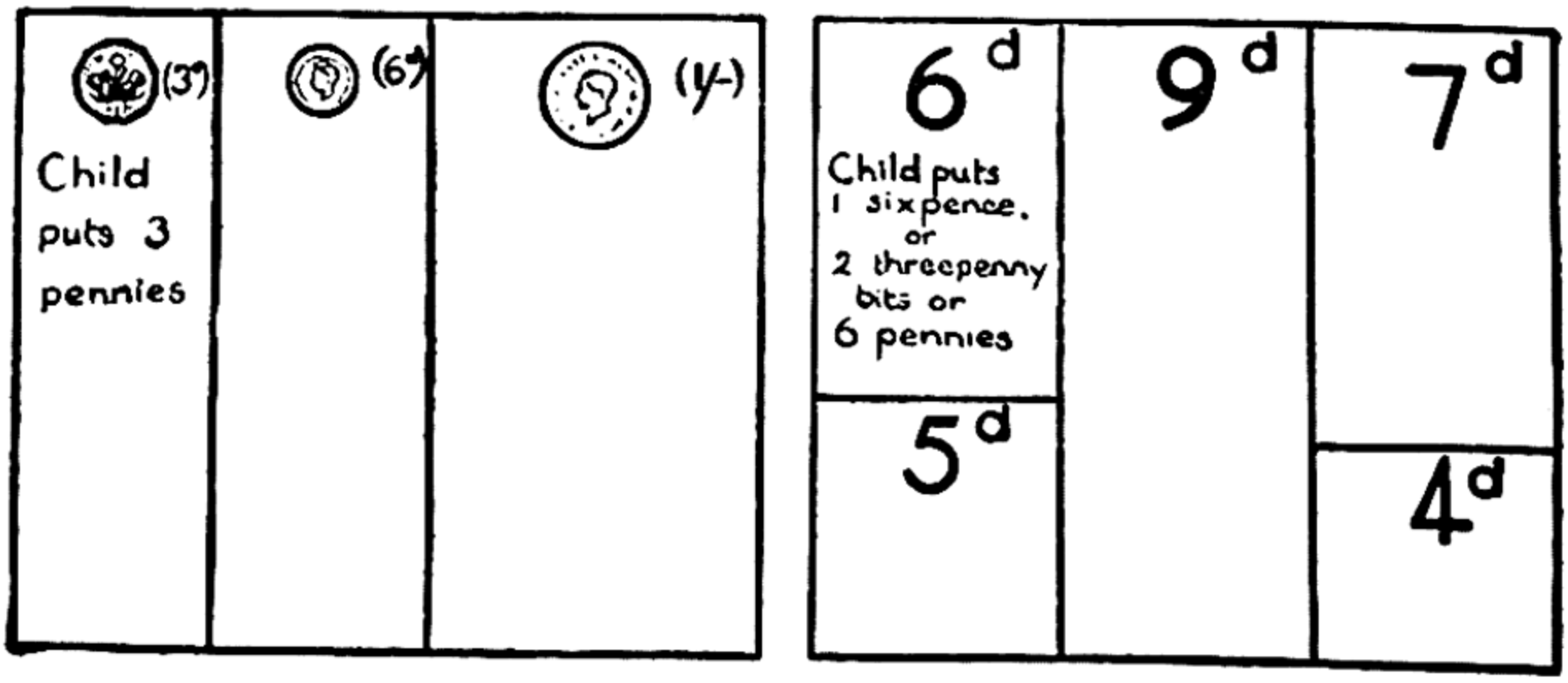


FIG. 28

As soon as the children are ready, similar cards introducing halfpence are used. Cards of this kind are used throughout the scheme to give practice as it is needed in money values.

ACTIVITIES WITH MONEY UP TO 1/-

On the whole the work at this stage keeps below the value of 1/-, although the children learn to recognize the 1/- coin, and should not be prevented from using it, if they wish, in actual shopping. Halfpence are not used until the children know the coins up to 1/- and are able to work simple addition and subtraction sums. When they can recognize price tickets up to 1/-, further directed activities are introduced; for example:

a. Two objects are purchased, pictures are drawn, prices are recorded, the amount spent is added. Later more than two

objects are bought. It is wiser to give the children a limited amount of money for shopping or the numbers will get beyond their capacity. Price labels, too, should be small in value.

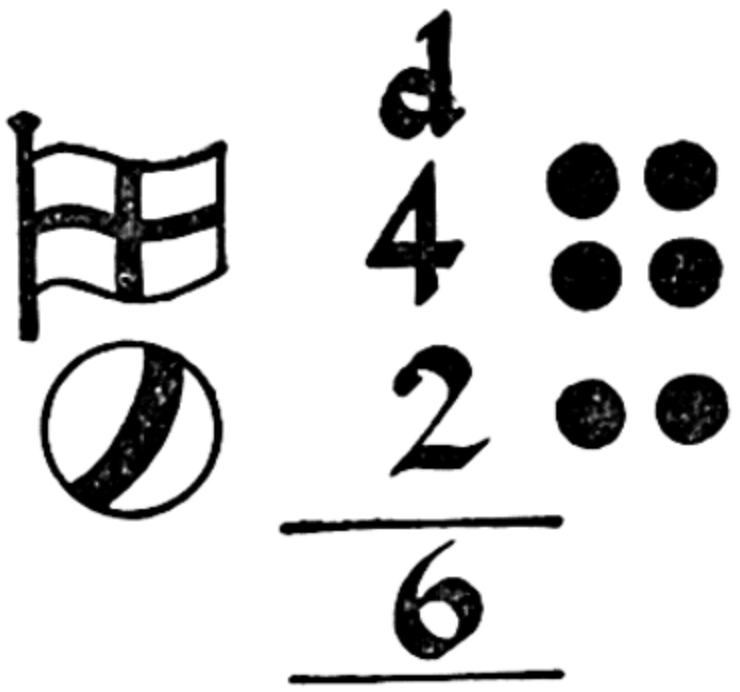


FIG. 29

b. The first idea of subtraction is introduced when the children, after a shopping activity such as described above, not only know how much they have spent but also how much they have left.

c. Practice cards are introduced when the children have had plenty of practice in shopping and adding the prices of their purchases. On cards which measure not less than 10×8 in. are drawn two pictures of money-boxes, purses, or handbags. The sums can either be printed down the middle of the card as in Fig. 30, or on separate slips to fit a space left in the middle. The child has a supply of coins. To work the first sum in Fig. 30, for instance, he puts 4 pennies in one purse and 3 pennies in the other, and then counts them up. Before long he can learn to write his sum in his book: $4d.+3d. = 7d.$ If these picture cards are arranged four in a box with a number of separate sum cards to fit down the middle, a group of four children have material for a considerable amount of practice.

Subtraction cards work on the same plan. (Fig. 31.)

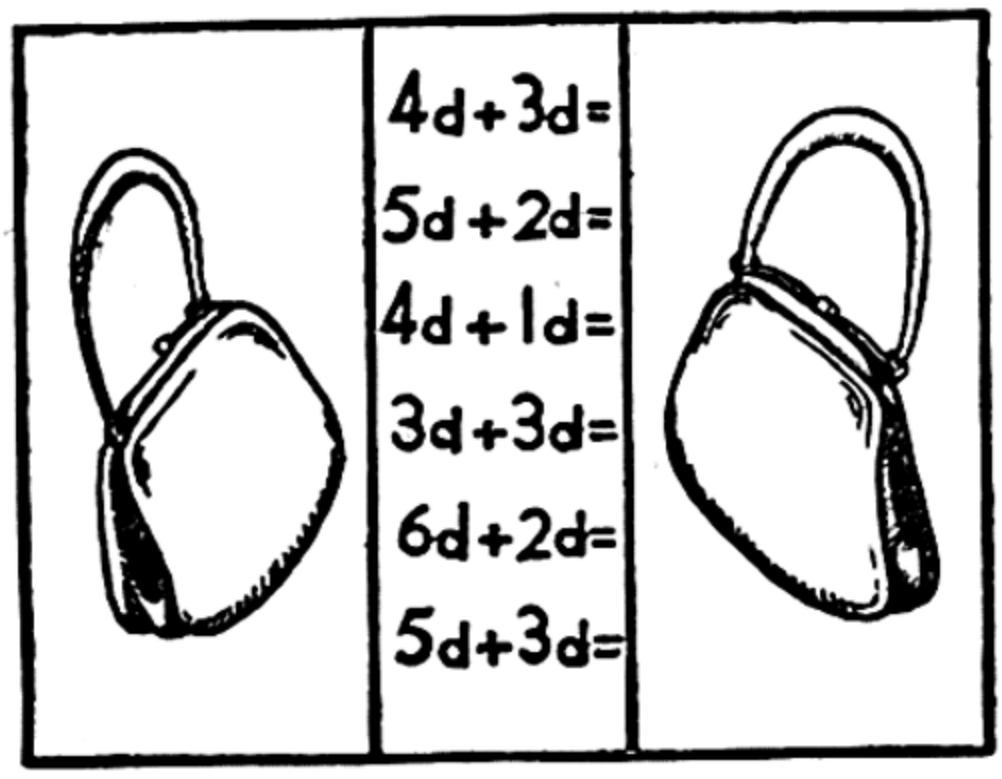


FIG. 30

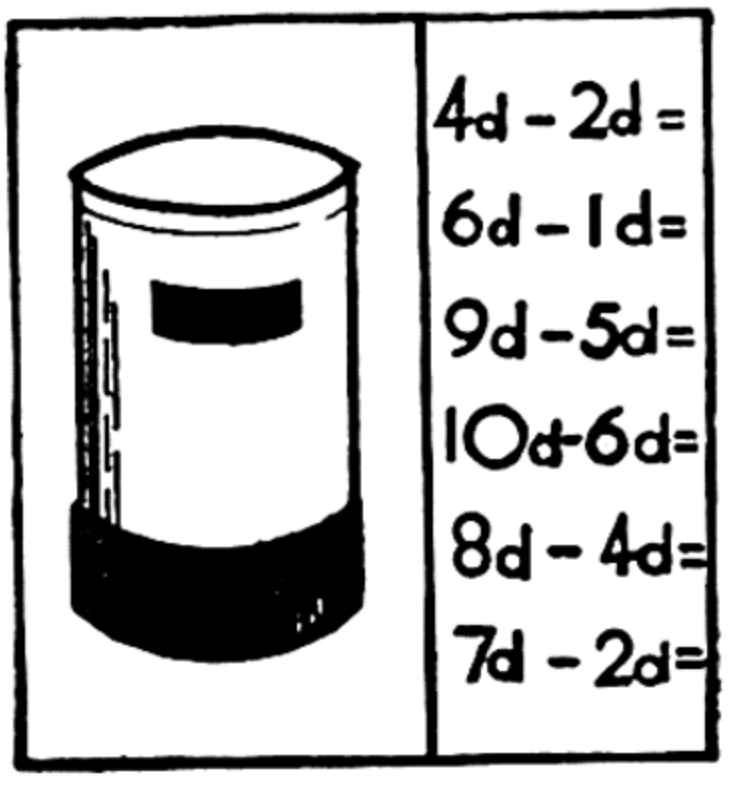


FIG. 31

Quite definite teaching is needed when purchases are to be recorded in sum form, i.e. arranged vertically. The practice cards should be planned in stages. At first the sums should involve only whole pennies.

$$\begin{array}{r} 4d. \\ +3d. \\ \hline \\ \hline \end{array}$$

Then one halfpenny should be introduced.

$$\begin{array}{r} 3\frac{1}{2}d. \\ +2d. \\ \hline \\ \hline \end{array}$$

Then the sum should involve two halfpennies.

$$\begin{array}{r} 2\frac{1}{2}d. \\ +4\frac{1}{2}d. \\ \hline \\ \hline \end{array}$$

The children must be taught to deal with the halfpennies first, for instance, in the third stage, to put the two halfpennies together to make a penny before adding the other numbers.

Subtraction should also be dealt with in stages:

(1) $\begin{array}{r} 7d. \\ -4d. \\ \hline \\ \hline \end{array}$ (2) $\begin{array}{r} 10\frac{1}{2}d. \\ -\ 6d. \\ \hline \\ \hline \end{array}$ (3) $\begin{array}{r} 9\frac{1}{2}d. \\ -4\frac{1}{2}d. \\ \hline \\ \hline \end{array}$ (4) $\begin{array}{r} 8d. \\ -2\frac{1}{2}d. \\ \hline \\ \hline \end{array}$

Finally, the child should be able to deal with a mixture of all kinds. In actual shopping the children deal with this easily, but in the writing down this careful grading has been found helpful.

When children are really sure of coins and their values up to 1/-, the giving of change becomes quite a simple matter and is introduced as a directed activity at this stage. It differs from the earlier work in subtraction because children have to face the problem that arises when they cannot offer the exact amount of their purchases. The class purses must now contain at first threepences and sixpences, then shillings, and finally a mixture of all coins. The shopman will need pence and half-

pence. It is possible to anticipate one difficulty: at first many children will offer more money than is really necessary, and they will need to be shown that it is more sensible and 'grown up' to give a sum as near the amount of their purchases as they can. For example, when buying an article at $4\frac{1}{2}d.$, to offer $5d.$ or $6d.$ is more sensible than to offer 1/-.

The same shopping activities as before can be used. Before long the children can be taught to record their purchases in sum form. (Fig. 32.)

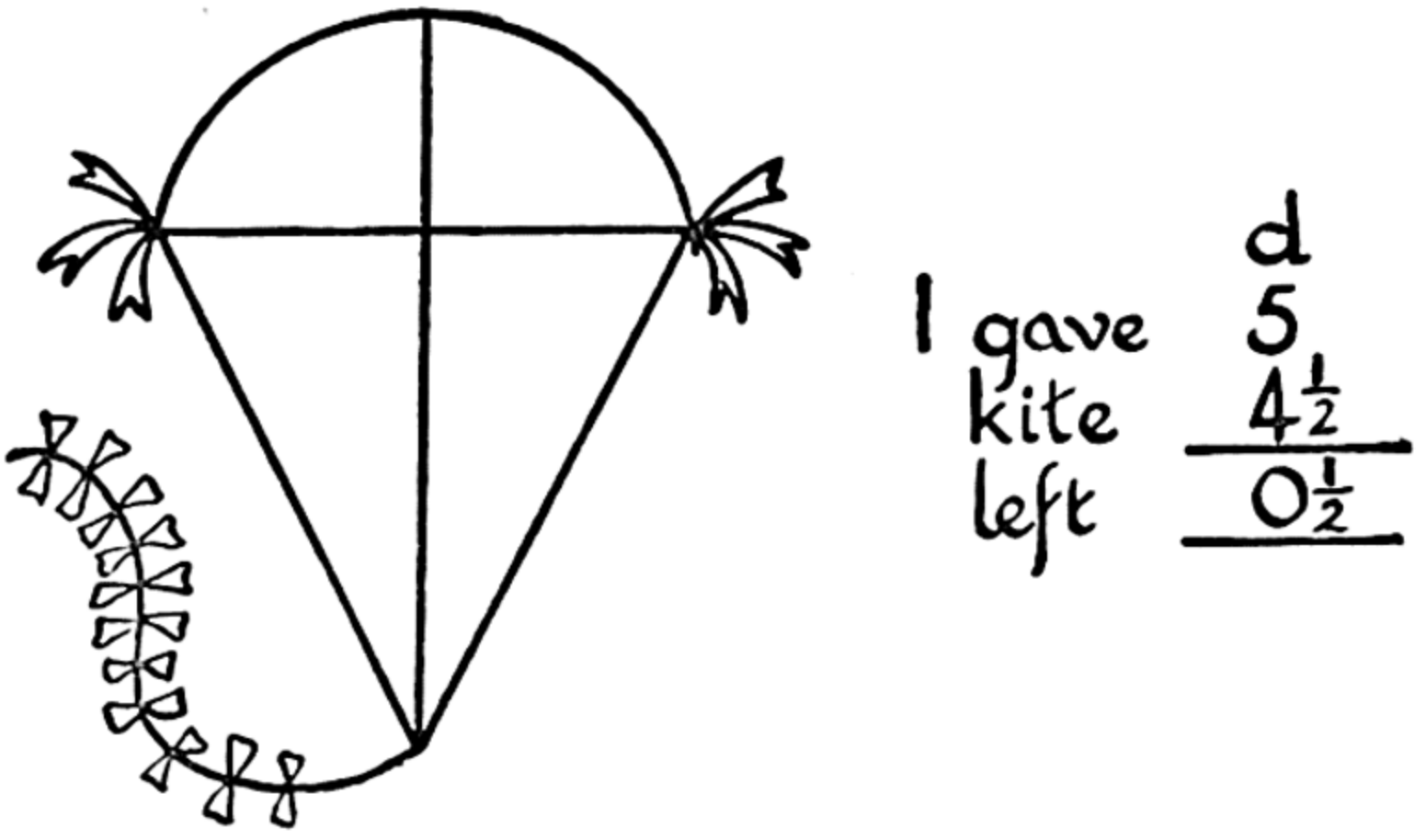


FIG. 32

At this stage the easier 'shop-window' apparatus as shown in Figs. 34 and 35 can be used.

MONEY UP TO 1*s.* 6*d.*

So far, although children have become familiar with a shilling as a coin, most of their work has been with money below a shilling. Now they are ready to carry out the same shopping activities and work the same practice cards, but with the use of larger amounts. A halt at 1*s.* 6*d.* has been found useful for consolidating the earlier work.

The changing of pence to shillings is learnt first of all through actual shopping experiences. When the children write out their bills, they set out the number of pence in two vertical rows—twelve in one and the rest in another. The twelve pence are changed for 1/-, and the answer is clear. (Fig. 33.)

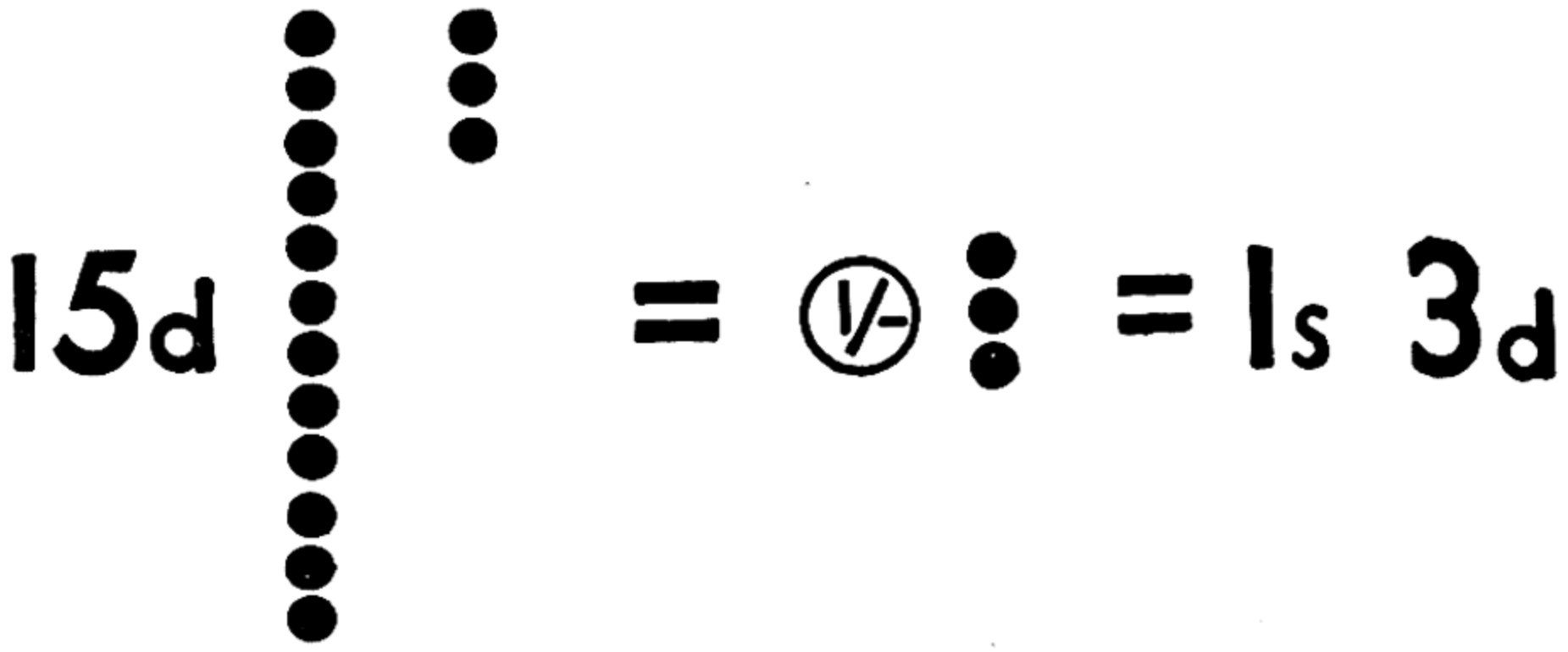


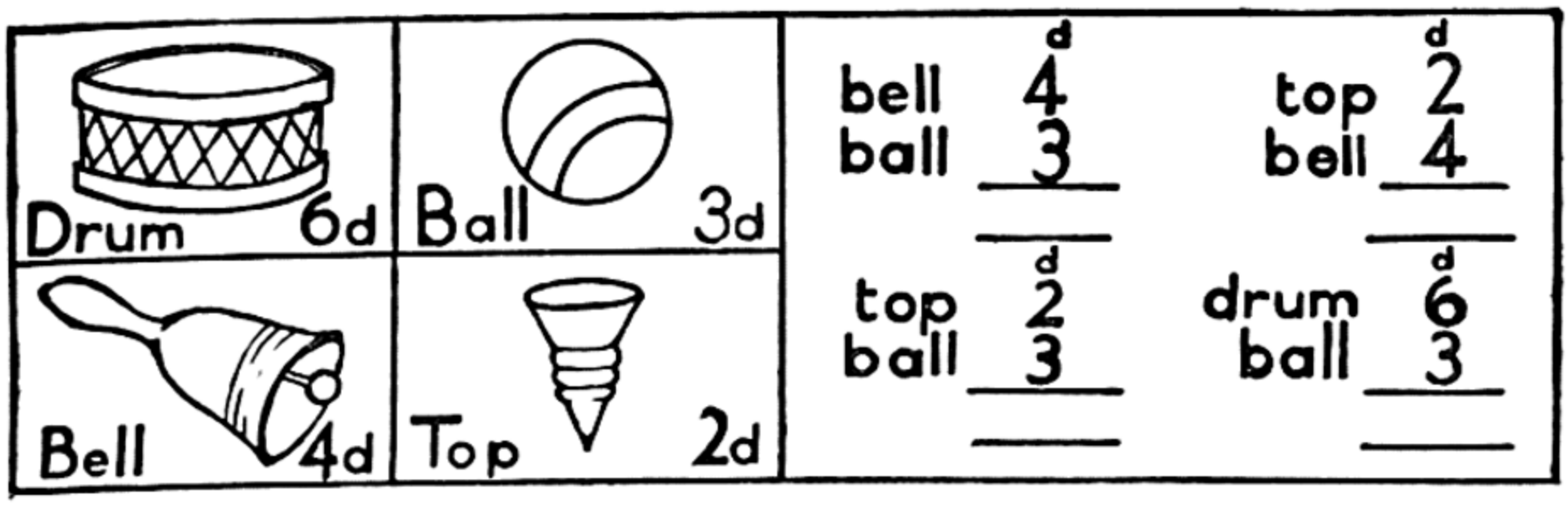
FIG. 33

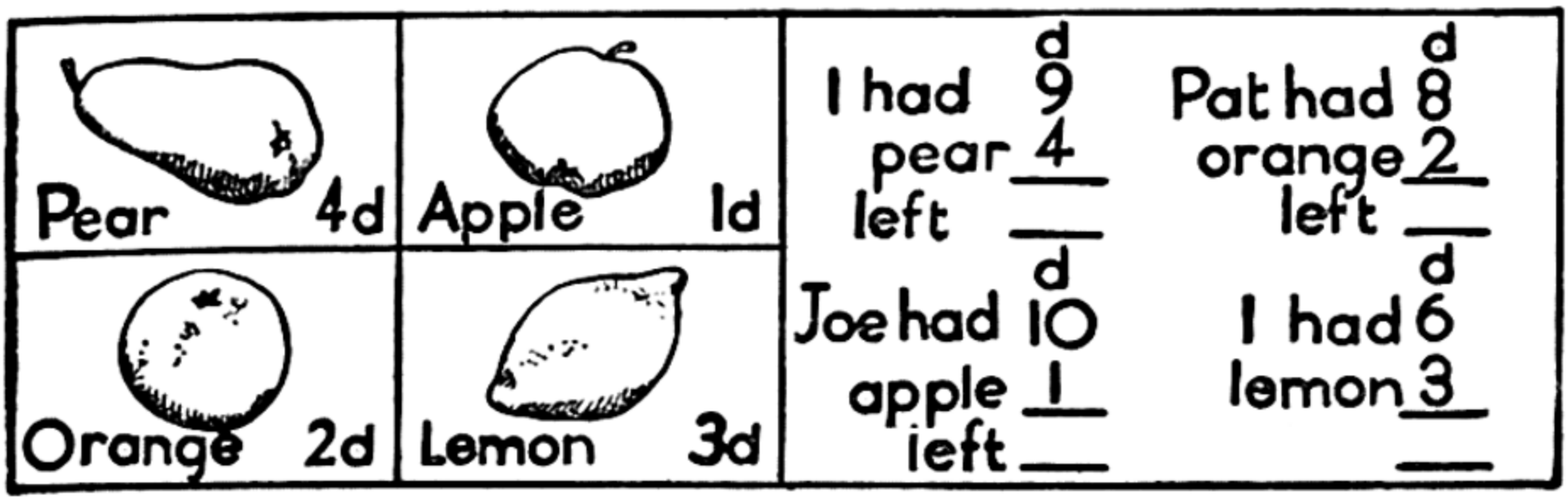
Practice cards dealing with this process should be used and worked with coins until these are no longer needed.

By now children are able to record their purchases in sum form. Two pieces of 'shop-window' apparatus to be used as supplementary activities for children not actually engaged in shopping, have been found useful. The simpler type have the bills made out, and these are copied by the children into their books and worked with or without coins according to the stage the children have reached. See Fig. 34 (Addition) and Fig. 35 (Subtraction).

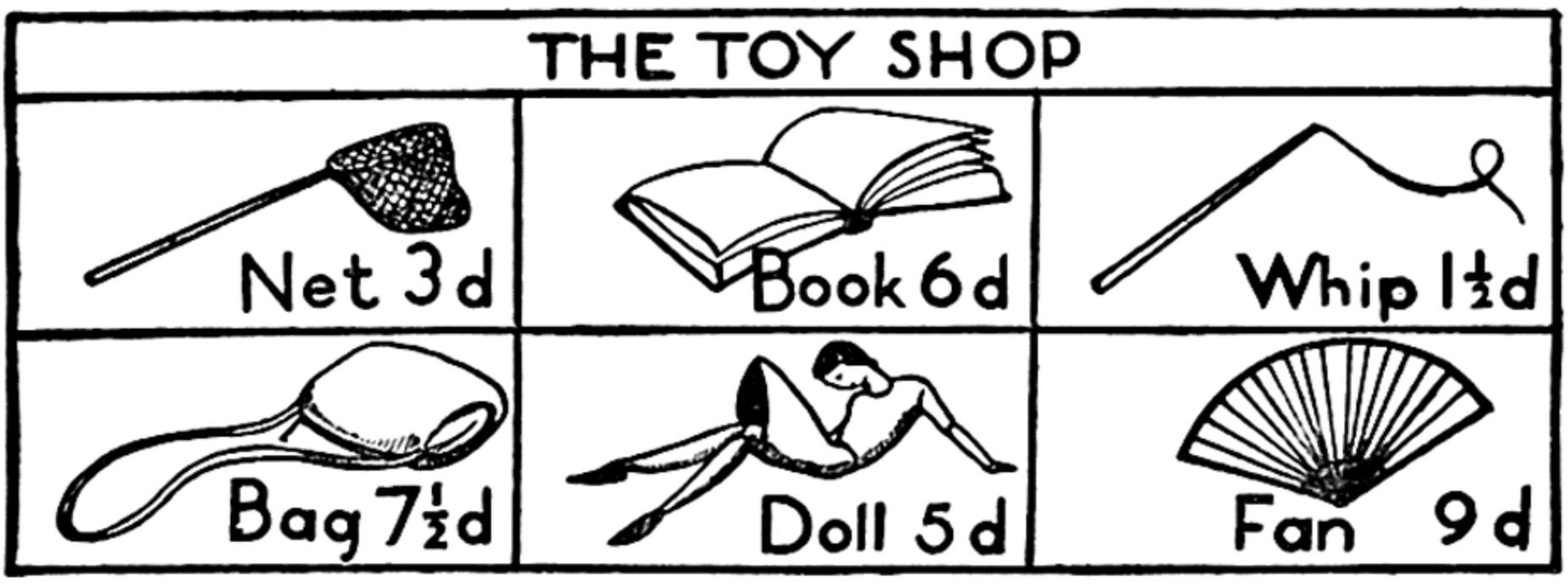
The more advanced type have pictures and prices, but leave the children free to construct their own bills. Before using these the children should have had a good deal of experience in writing down bills. Fig. 36 shows one for addition and Fig. 37 one for subtraction.

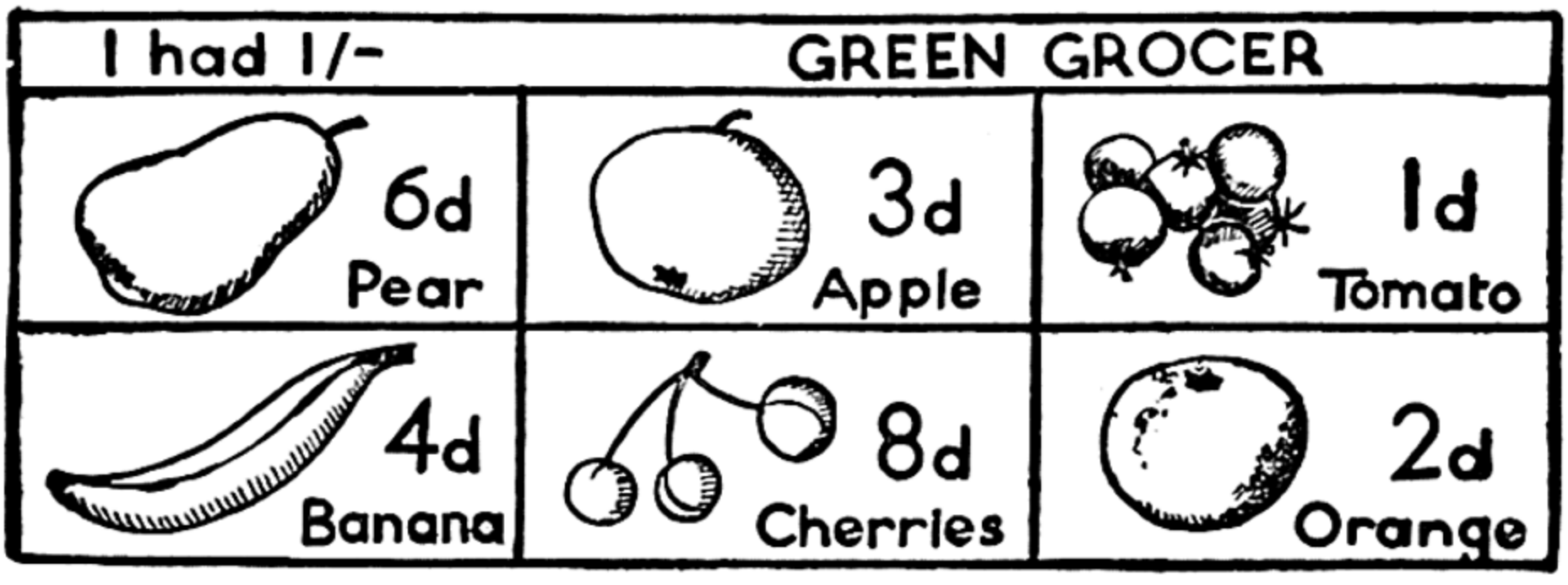
One matter remains to be mentioned: while the children are learning to work with halfpence, it has been found helpful to introduce a number of separate activities which give practice in counting and reckoning in twos, such as have been suggested in Chapter I on Counting. At the same time other experiences with halves in various kinds of measurement should be provided. Little is done to relate these activities, but they give a background of experience to the fractions of money. If, with an exceptionally forward group of children, farthings should be introduced, other work with fours and quarters should come at the same time.





FIGS. 34 and 35





FIGS. 36 and 37

Money up to 2/-

As soon as the children have consolidated their early work and are able easily to deal with the process of turning twelve pence into a shilling, the scope of activities can be extended to 2/-. The same type of apparatus will still be useful, and further varieties can be introduced.

If the children are interested, a draper's shop can be introduced. Here many of the goods are sold in pairs, dozens, and half-dozens, so that opportunities are given for practical work in multiplication and division. Individual cards and shopping lists are provided, and children set off to buy such things as are indicated on the specimen card. (Fig. 38.)

The teacher must be sure that the shop has plenty of stock—enough for all the cards to be used at one time.

Division cards are also provided. (Fig. 39.)

Buy 3 dozen buttons at 2d a dozen
Buy 2 pairs of gloves at 9½d a pair
Buy ½ dozen buttons at 5d a dozen

Fig. 38

Take Is .. 4d Buy belts at 4d each
Take Is .. 0d Buy collars at 6d each
Take Is .. 6d Buy reels of cotton at 2d each

Fig. 39

For all such calculations the children use coins until they no longer need them. They change the shilling into pence and then arrange the whole number of pence in the groups indicated by the divisor. As a matter of fact most children by this time know from experience the factors of numbers up to about

24. They will therefore probably of their own initiative skip the practical stage. The sum is then recorded—for instance, the first on the card, Fig. 39.

I took 1s..4d
I bought 4 belts at 4d each

FIG. 40

The children can be given further practice in addition, subtraction, multiplication, and division of money by the use of graded practice cards, so that at the end of the course they are able to tackle with confidence a mixed card involving all four rules up to 2/-.

(1)	(2)	(3)	(4)
$9\frac{1}{2}d.$	1*s.* 3*d.*	$6\frac{1}{2}d.$	4 | 1*s.* 4*d.*
$+5\frac{1}{2}d.$	$-$ 4*d.*	$\times 3$	

2. OTHER MEASUREMENTS—LENGTH, WEIGHT, CAPACITY, AND TIME

A. LENGTH

Introduction. The child is given a packet containing several lengths of cardboard 1 in. to 5 in. long. He finds and places side by side pieces of equal length. For another exercise he grades the lengths beginning with the shortest. Given lengths of wallpaper ribbon and a small cardboard measure, the child cuts off as many equal lengths as possible.

Shopping Activity. The child now combines his knowledge of length with his understanding of the value of pence, and buys lengths of ribbon for any number of pennies up to 5*d.* The measure is a piece of stiff cardboard divided into 5 equal divisions, which are coloured alternately and marked with the price near the dividing line.

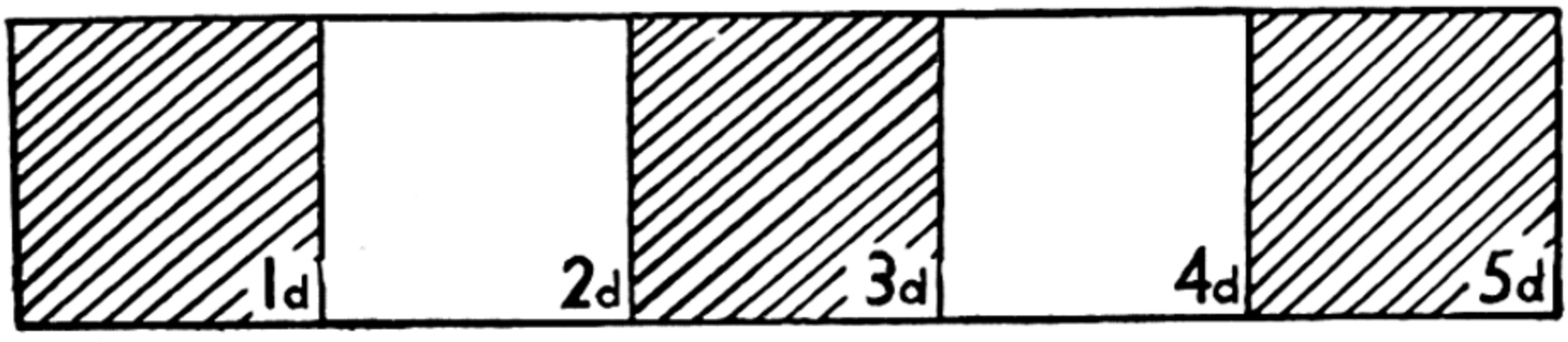


FIG. 41

The shopkeeper places end to end the ribbon and measure, which lies flat on the counter, and cuts off the required amount. The child draws round the actual pieces bought, and writes the price.

The Ruler—Foot, Inch, Half-inch, Yard.

The Foot. Placing toe to heel, the children step the distance between certain points, e.g. from door to cupboard or along a line drawn on the floor. The teacher does the same, and the children note that in her case less steps are taken to cover the same distance. The need for a uniform measure is thus shown. Using foot rulers made of plain stiff cardboard, the children measure the length of the desk, width of door, &c.

The Inch. The children will note that some things, books and pencils, for instance, are too short to be measured with a foot ruler. They are told that a foot can be divided into 12 inches. Each child is given a cardboard ruler divided into 12 divisions and 12 1-inch pieces of coloured paper, 6 of each of 2 colours. The child pastes these pieces alternately in the spaces provided, writes figures 1 to 12 near the dividing lines, and writes the word 'inches' in the bottom left-hand corner. (Fig. 42.)

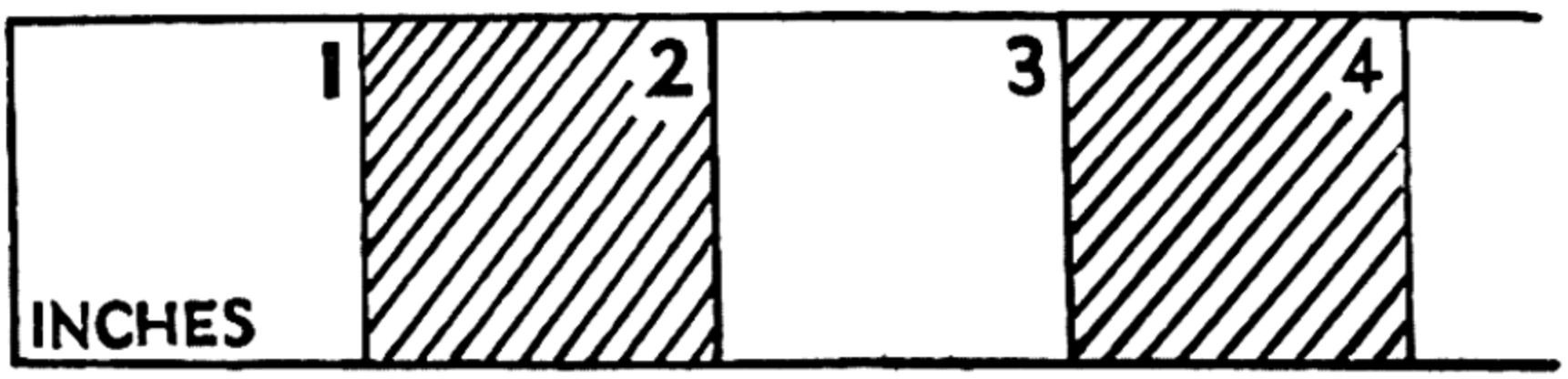


FIG. 42

With this ruler he measures his pencil, books, crayon-box, &c. Lines of varying lengths are drawn in the child's book by the teacher. The child measures these with his home-made ruler, and writes the length in inches underneath each line. The child draws lines to indicate a required length, following a direction, such as 'Draw a line 5 inches long'.

Half-inches. The children are next introduced to a real ruler and taught how to use it, starting at the correct place and ignoring 'the little bit at the end'. The position of the half-inch

mark is shown, and the children are given practice in measuring lines and recording lengths. The children are asked to draw lines to indicate required lengths in inches and half-inches.

The Yard. In order that the children may be given shopping experience dealing with length, it is necessary to introduce a yard measure, as the foot is rarely used in ordinary shopping. As in the case of the first foot rulers, the child makes his own yard measure before using it. As it is difficult to obtain cardboard 36 inches wide, the measures are made in two equal parts, so the fold will actually mark the half-yard. Each child is given three 1-foot lengths of different coloured paper 1-inch wide. He divides each foot into 12 inches by marking the inches at the top and bottom of each length and joining the dots. One foot length is then cut in half, and one whole length (12 in.) plus one half-length (6 in.) are mounted on each of two pieces of stiff cardboard 18 in. × 1 in., care being taken to see that the two half-portions come in the centre when the two pieces are joined.

A strip of linen adhesive tape placed at the back will effectively join the two half-yards. The numbers 1 to 36 are written near the dividing lines.

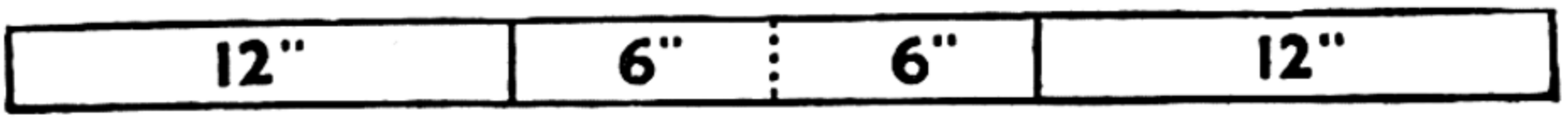


FIG. 43

This rule can now be used for teaching.

12 inches = 1 foot
3 feet = 1 yard
36 inches = 1 yard
18 inches = ½ yard

In addition it can be folded for storing.

Shopping Activity. The yard measure can now be used for buying materials at the draper's shop in yards and half-yards. The money spent on one piece should not exceed 2/-. The yard measure is fastened to the edge of the desk, and the child places the material along it when he is measuring.

Individual cards are used for further practice.

A specimen card reads:

Buy 2 yards of print at 9d a yard
Buy 4 yards of braid at 4½d a yard
Buy 8 yards of lace at 2d a yard

FIG. 44

The child records each purchase,
e.g. 2 yards of print at 9*d*. yard costs 1*s*. 6*d*.

B. WEIGHT

Home-made scales are used for the first weighing lessons. The one shown in the sketch was made from a child's discarded blackboard and stands about a foot high. Patty tins provide the scale pans. Shells are used for weights.

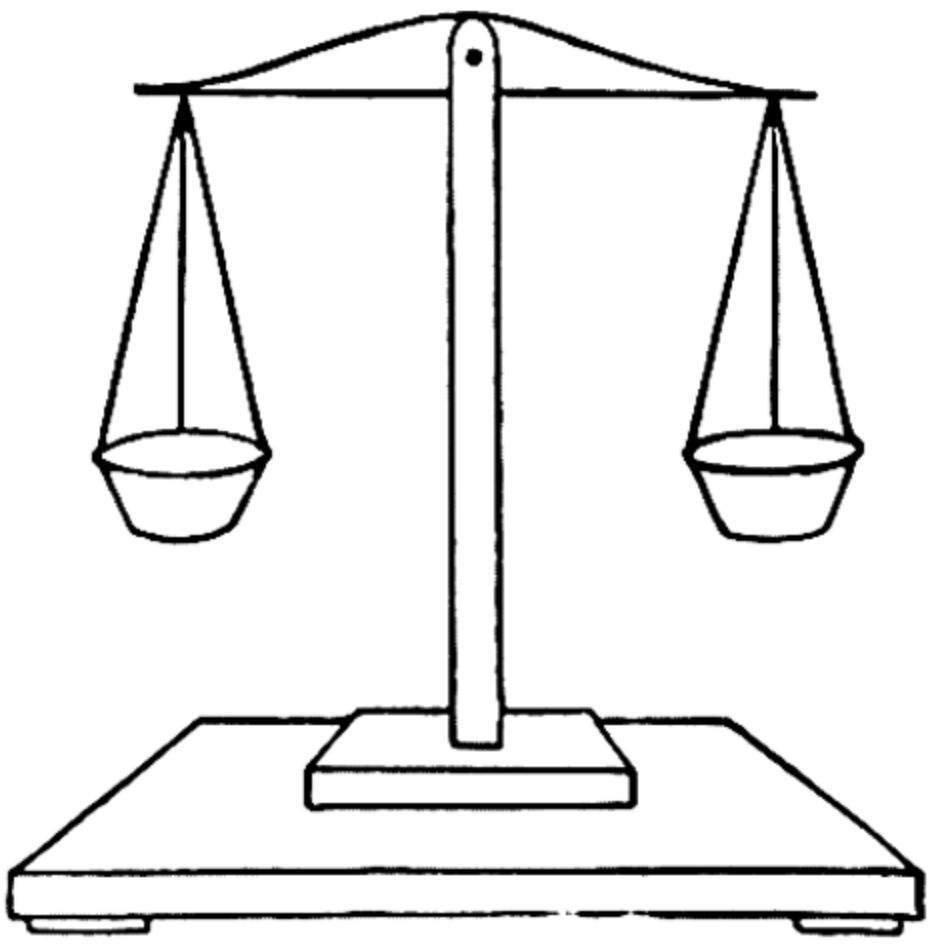
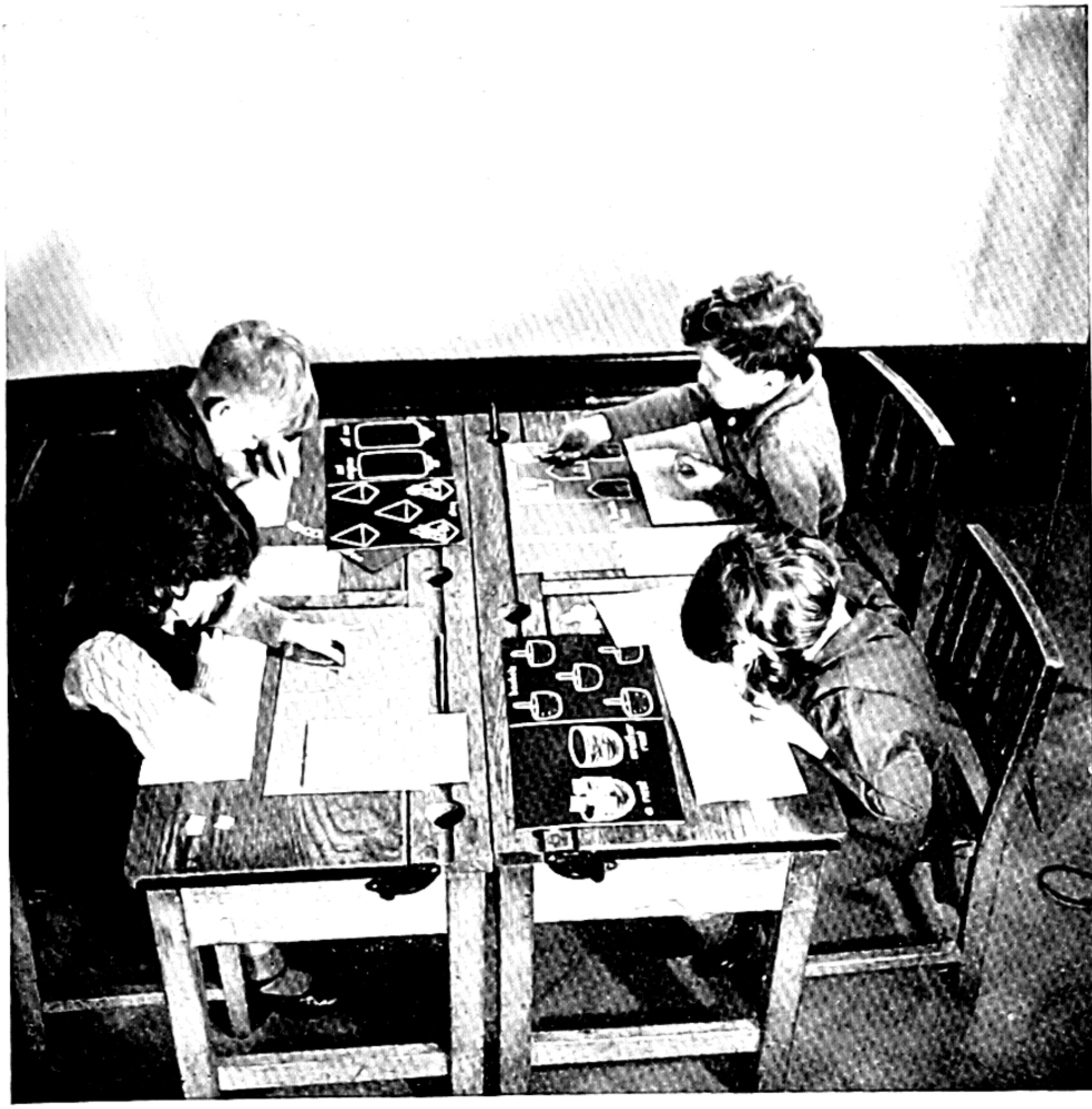
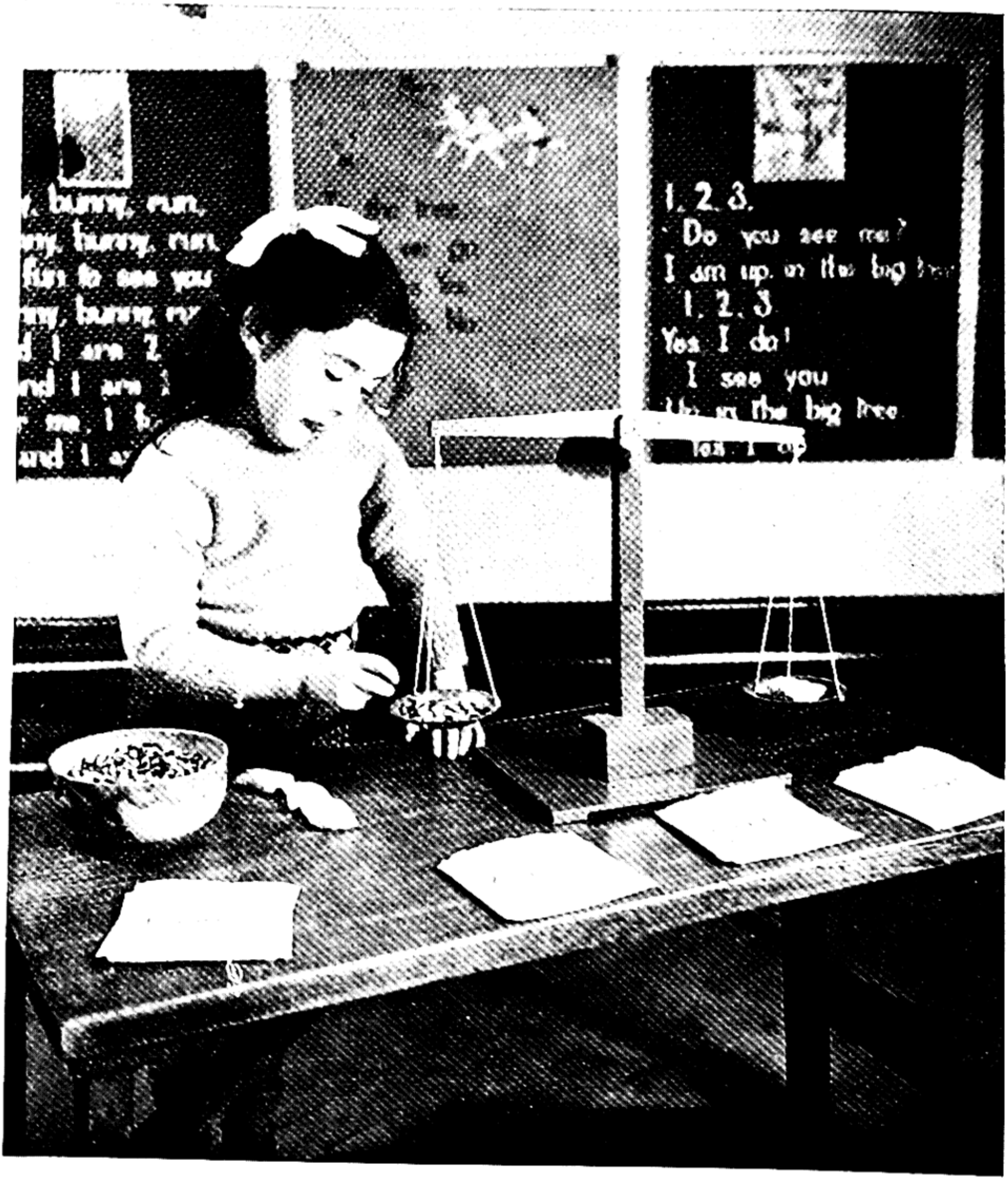


FIG. 45

Introduction. The children work in groups of four with one pair of scales to each group. They learn to balance a quantity of sugar (sand) or sweets (coloured peas or beans) against one



A GROUP IS BUSY DOING PROBLEM SUMS WITH THE HELP OF PRACTICAL APPARATUS



FIRST EXPERIMENTS IN WEIGHING

Home-made scales and weights are being used, and coloured beans serve as sweets

or more shells. They also learn to transfer whatever they weigh to a small paper bag without losing any. This makes them realize from the start the importance of accuracy in weighing.

Shopping Activity. (*a*) The child combines his ability to weigh with his knowledge of money. He buys or sells sweets for 1*d.*, using one shell to represent one pennyworth. He then draws the scales simply, showing his one shell and number of sweets given for it.

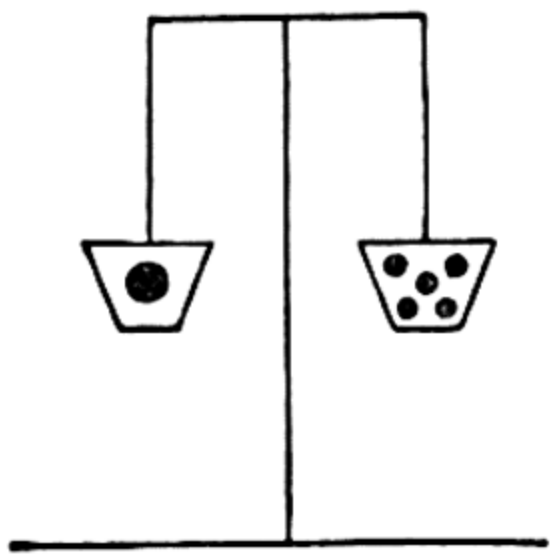


FIG. 46

(*b*) The child next learns that the number of pence paid will determine the number of shells to be used, e.g. 2 shells for 2*d.*, 3 shells for 3*d.*, &c. He buys sweets for 1*d.*, 2*d.*, &c., and makes a pictorial record of his activity.

The Ounce and the Pound (*lb.*)

The Ounce. The teacher talks about the shopkeeper's scales and weights. An actual 1-oz. weight is shown, and also the home-made weights which the children will use at this stage. These are made by filling small linen bags with 1 oz. each of sand and sewing them up securely. '1 oz.' is written on each bag.

The children are given practice in weighing 1 ounce, 2 ounces, &c., of sweets, and afterwards put them into bags which have weights marked on each.

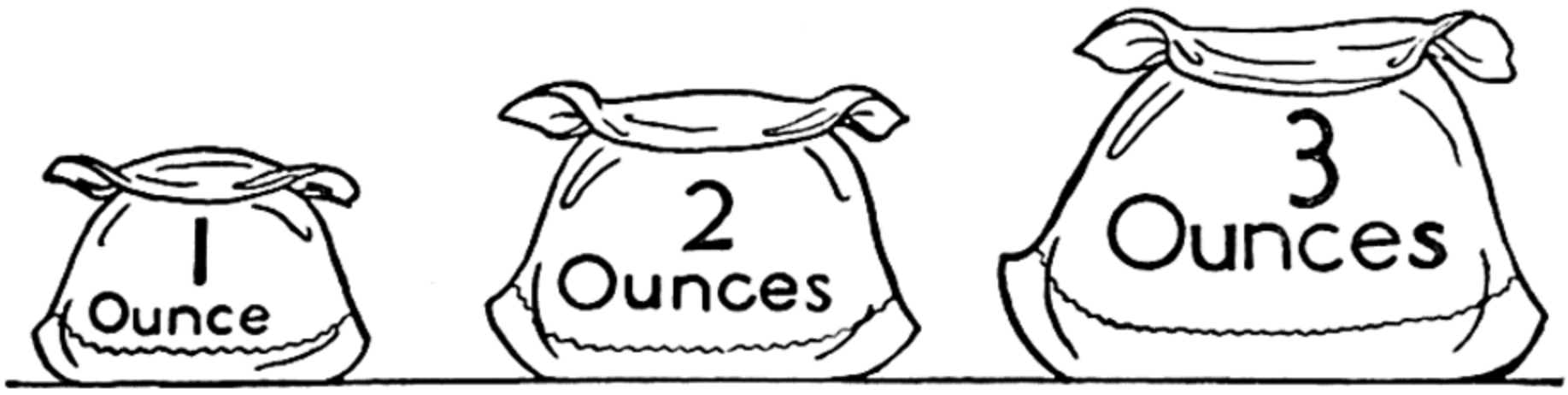


FIG. 47

This tells the child the amount to be weighed, and also enables the teacher to check up the weights without loss of time at the end of the activity.

Shopping Activity. The child buys sweets at the sweet shop. These are priced at 1*d.*, 2*d.*, &c., per ounce (pence only). He may spend up to 10*d.* on one kind. He first copies down the price label when making a record of his purchases.

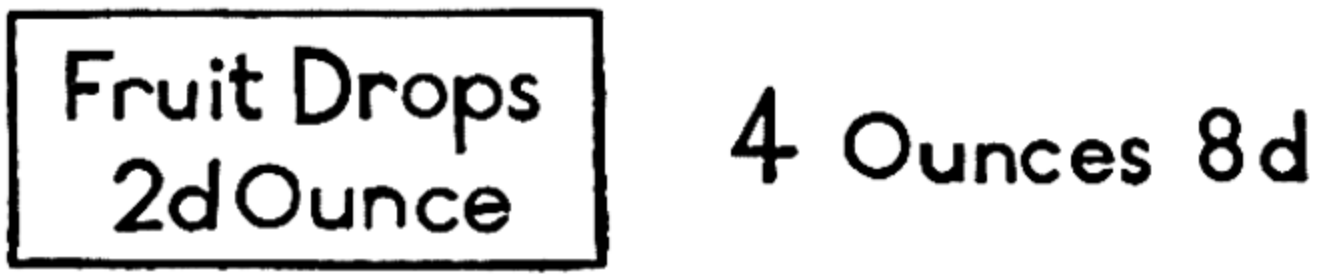


FIG. 48

Usually several labels are available so that each child can take one with his sweets.

Weights from 1 oz. to 8 oz. and 1 lb.

Actual weights and scales are next introduced—1 oz., 2 oz., 4 oz., 8 oz. The children are given practice in using these weights to prove their relationship to each other. For instance, through practical experience they will discover that an 8-oz. weight will balance four 2-oz. packets of sweets, or that four of the home-made ounce weights used in the earlier stages balance the 4-oz. weight.

The child buys 1 oz., 2 oz., or 4 oz. of sweets, using one weight only for each transaction. Sweets are priced at not more than 3*d.* per ounce, so that the cost will never exceed 1/-. As before, the child copies the price label and makes a statement.

Shopkeepers are changed frequently during the lesson to give each child a chance to weigh.

1-lb. weights. 1-lb. and 2-lb. weights, as used in the greengrocer's shop, are next introduced. By balancing 16 home-made weights against the 1-lb. weight, the children learn that 16 oz. = 1 lb. In the same way they also learn that the weight marked 8 oz. represents $\frac{1}{2}$ lb.

The children buy $\frac{1}{2}$ lb., 1 lb., or 2 lb. of fruit or vegetables at the greengrocer's shop, using one weight only each time.

Goods are priced up to 6*d.* per lb. Labels are provided for children to copy.

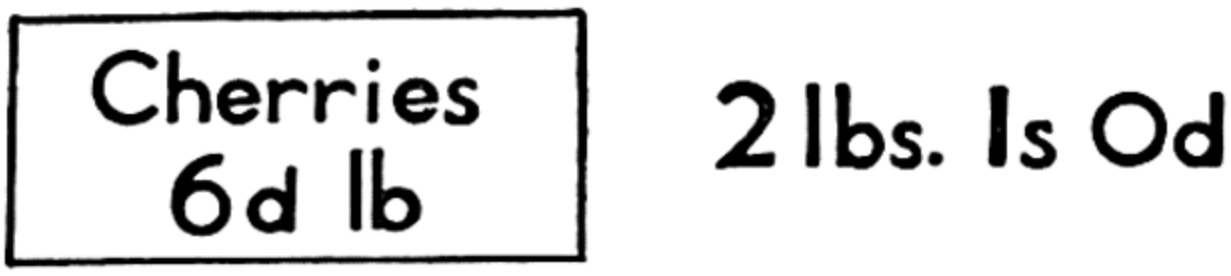


FIG. 49

The children buy 1 oz. to 8 oz. at the sweet shop, using one or more weights as required. For instance, the child will use the 2-oz. and 1-oz. weight for 3 oz. He may now spend up to 2/- at one visit to the shop. An example of a child's record reads:

Caramels 2*d.* ounce,
8 ounces cost 1*s.* 4*d.*

The children buy ½ lb. to 3 lb. at the greengrocer's shop, using one or more weights as required. The child spends up to 2/- as he did at the sweet-shop. He makes a record of his purchases using the shop price-list for reference.

C. CAPACITY

The first necessity is several small enamel jugs containing water, coloured to represent milk or lemonade, and a measure. An egg-cup makes a suitable one for this step. Little children find the pouring from bottles very difficult, and are apt to pour the greater part over themselves and the table; but they can manage the jugs if not too full. Even so, it is as well to arrange for them to do their pouring out over a large bowl in case of accidental spills.

Introduction. The child learns to pour out water into a small measure and use it to fill a larger vessel. For instance, he may fill a jug using an egg-cup as a measure. He can at this stage count the number of times he fills the egg-cup.

Shopping Activities. Each child in the group takes a turn at buying and selling milk, lemonade, &c., at 1*d.* per measure. The buyer takes a small jug or bowl to receive it. He records his shopping by drawing the measure with the price paid,

i.e. 1*d.* The child now learns that for 2*d.* he will have 2 measures full, for 3*d.* 3 measures, &c. He buys milk for 1*d.*, 2*d.*, &c., and makes his record accordingly.

Each child is given practice in finding the number of smaller measures required to fill a larger one, and afterwards draws a picture to illustrate his result.

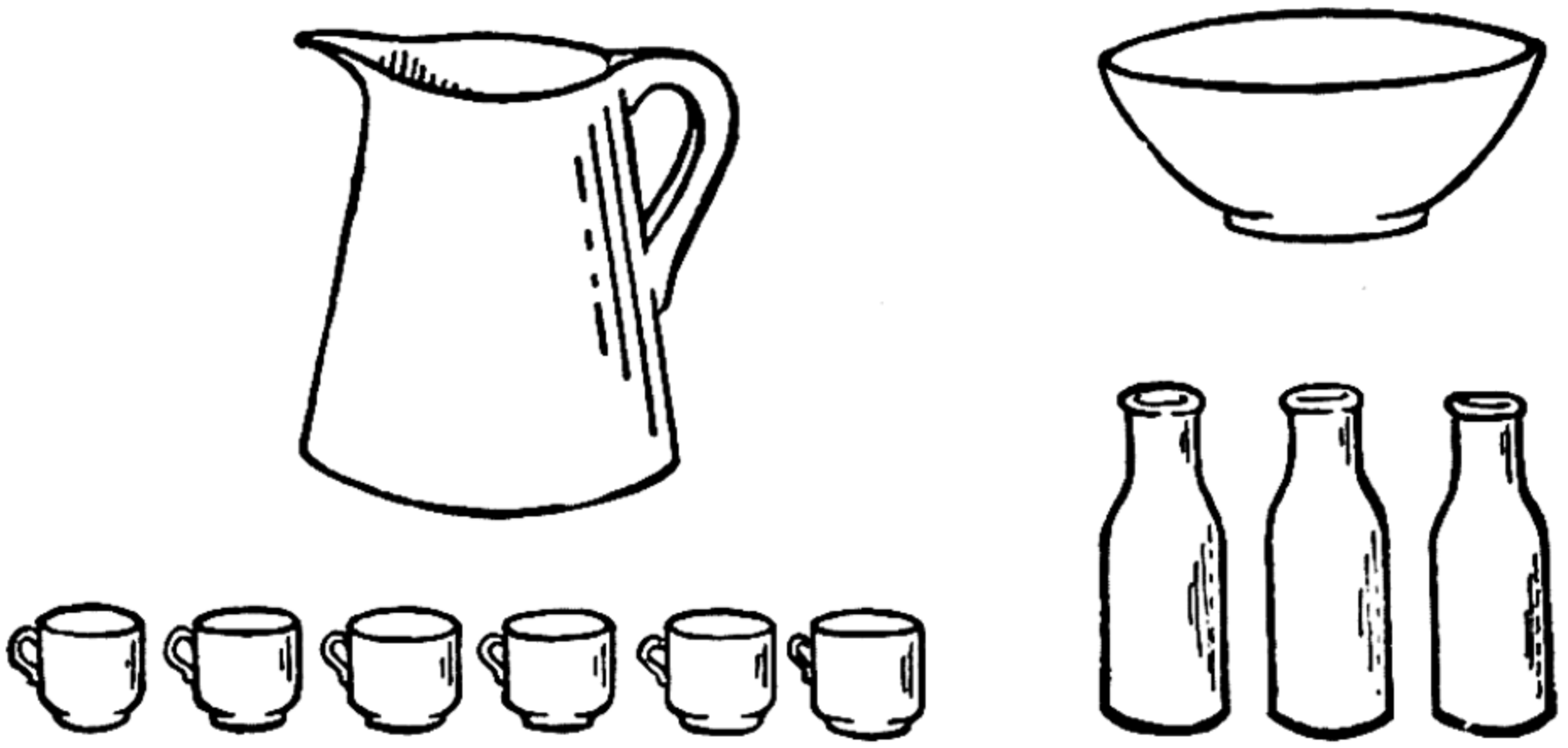


FIG. 50

Pints, Half-pints, and Quarts

The Pint. The teacher refers to the milkman who brings a pint, 2 pints, &c., of milk, and the way he measures it. She shows a pint measure. The children fill jugs or bowls using the pint measure and record their activity.

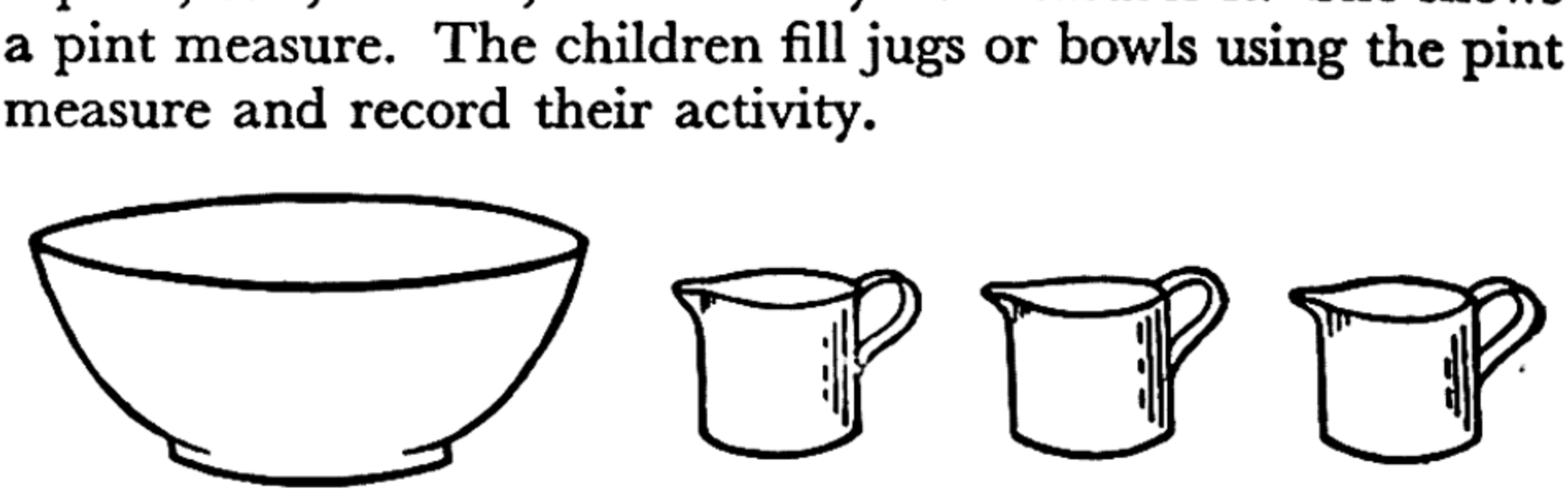


FIG. 51

The child buys 1 or 2 pints of lemonade, milk, &c., priced in pence no higher than 5*d.* (10*d.* is his limit of spending at this stage). He writes a simple statement in his book about his shopping, e.g.

Lemonade 3*d.* a pint
2 pints 6*d.*

Half-pints and Quarts. The teacher introduces practical work with half-pint, pint, quart and, if possible, even gallon measures. By using the smaller measures to fill the larger, the children discover:

2 pints = 1 quart
2 half-pints = 1 pint
4 half-pints = 1 quart.

The children draw their results to help to impress these number facts.

FIG. 52

(*a*) The child buys half-pint, pint, or quart of milk or fruit juice from the milk-bar. The liquids are priced in pence per pint so that the maximum quantity (quart) will not cost more than 1/-.

(*b*) The child buys half-pint, 1½ pints, and quart of liquid up to 1/- a pint, so that a quart will not cost more than 2/-. He now refers to the shop price-list when making his written statement of his shopping, e.g.

Cherry Soda 9*d.* a pint,
a quart costs 1*s.* 6*d.*

D. TIME

All children are interested in clocks and their purpose, and to learn to tell the time is quite a natural thing for a very young child to do. Even so it is difficult, and some teachers prefer to leave it until the last year in the infant school. It is a form of measurement, however, and just as it is possible to make simple beginnings with length, weight, and capacity, the same can be done with time. Lessons on time can be given as class

lessons, as it is an aspect of number which can be treated independently.

A large toy clock with loose 'fit-in' figures is used for the first lessons. With these the children learn to place the figures in the correct position. For an individual exercise each child is given a hectographed picture of a clock face with the centre marked and a small dash drawn where each figure is to go. This is done to impress the importance of good spacing as small children are apt to crowd all the figures to one side. The child fills in the figures, copying from the blackboard.

After a little preliminary work of this kind, the time measurements are treated in the following order: (*a*) Hours (clock time); (*b*) Half-hours (half past); (*c*) Quarter to and quarter past the hour; (*d*) Minutes.

The teacher introduces each new step through a clock large enough for all children to see. Each child is given a smaller toy clock, with hands which he can move about to show whatever time is required.

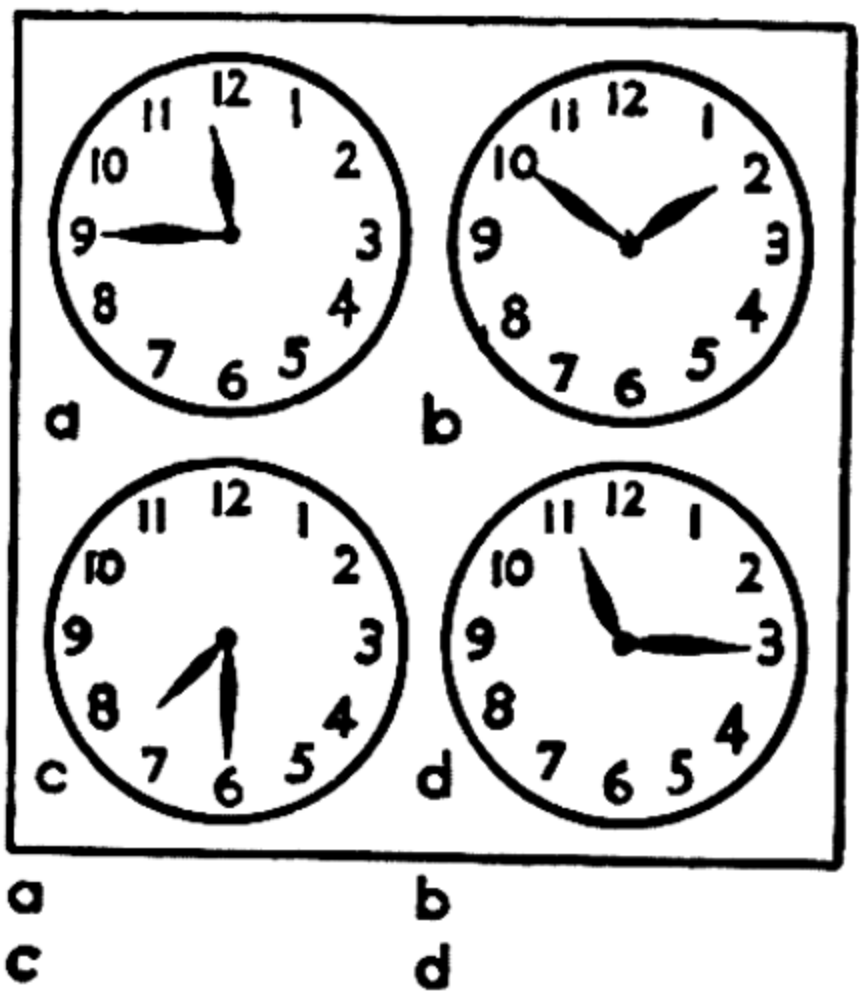


FIG. 53

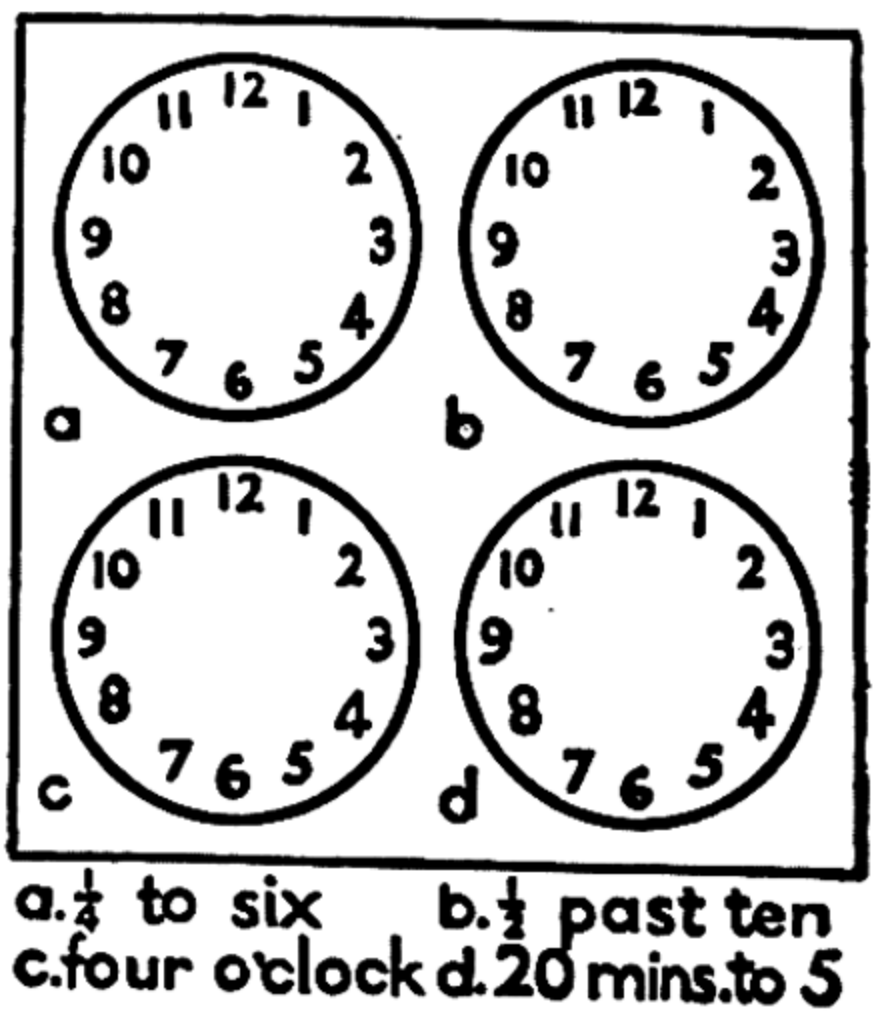


FIG. 54

(*a*) Hectographed pictures of clocks with hands drawn in position are given to the children. They write under each clock the time which that clock says.

(*b*) Clocks with hands missing are given to the children. The child draws in the hands to show the time asked for.

He writes the times shown on slips of paper and matches them to the corresponding clocks.

For further experience, exercises in time are included in the problems given at this stage. Problems such as these might be given.

(*a*) John went to play in the park at 2 o'clock. He stayed for $2\frac{1}{2}$ hours. What time did he return home?

(*b*) It is a quarter to 7. Mother says Mary must go to bed at 7 o'clock. How many more minutes can she play?

VII

PROBLEMS

BEFORE leaving the infant school children may be expected to work very simple problems. Many teachers find this a difficult part of their work; and children, who up to this point have been successful in number work, are often puzzled and discouraged by their inability to work these new sums. An examination of the phrase 'problem sums' may throw some light on the cause of this difficulty. Quite early in number work children can answer correctly such a question as, 'If you have two sweets in the bag and two more in your hand, how many sweets have you?' Problem sums introduce a new step. Children are expected, not only to give the answer, but to realize the kind of sum that the question asks them to do. They must be able to think 'That is an addition sum', and to write down $2+2=4$. This piece of abstract reasoning is a big step for children, and although some of them may be ready for it by the time they are seven, many will not be. A great deal can be done to prepare children for this step, and those who are accustomed to working out practically the number situations of everyday life and are able to think in realistic terms, will take the new step with comparative ease. Yet, however carefully children may be prepared for problem sums, there will be some who will not be ready to deal with them by the end of the infant school, and conscientious teachers should bear this in

mind. They should remember, too, that much of the good work they have done in laying foundations in number work may be destroyed if children are made anxious by being forced to take a step before they are ready.

There is no need to wait until children reach their last year in the infant school before beginning to prepare for problem sums. If the work is arranged in easy steps and suitable apparatus provided for the initial stages, they will form the habit from the start of applying their number knowledge to situations within their experience. It is for this reason that story sums hold an important place in the early stages, that is, before children can read or write. Drawing is used as a substitute, and in this way children experience number situations in a realistic setting and are trained to disentangle the sums from the stories. Story sums are taken when children can count and know the value of numbers to 6. Two of the many suitable stories which can be used are 'The Three Bears' and 'The Little Coal Truck'. The children can be asked to draw the 3 basins, 3 beds, 1 little girl, &c. The second story is a good example of comparison in size. Little boys, especially, love to draw the big engine in its siding with the little engine puffing away up the hill. Sometimes for a change the children are asked to carry out a few simple directions.

(1) Draw 3 flags—a blue one, a red one, a green one.
(2) Draw a money-box. Put 5 pennies in it.
(3) Draw a bag. Put a *lot* of sweets in it.
(4) Draw another bag. Put a *few* sweets in this one.

Story sums are continued while the children are working through the practical stages of the four rules to 10. As before, since reading is still outside the children's capacity, the teacher's oral directions and drawings are used as a substitute. Simple problems following the teaching of each rule are dictated to the children. For instance, for work on addition they might be given the following: 'Draw 2 baskets. Put 4 eggs in one basket, 3 eggs in the other. How many eggs in both baskets?' Having counted up the eggs, they write the answer, 7 eggs. A sum is not required at this stage. Any word to be included

in the answer is written on the board. After subtraction has been taught, they work problems on this rule, and then mixed problems on addition and subtraction. The same procedure is followed for multiplication and division. The problems are given first on the new rule only, and then the new rule mixed with those already mastered. This is done to ensure that the child understands the number situation involved in the story and knows what to do to find out the answer.

A word might be said here about division. It requires slightly different treatment from the other rules. It is quite a straightforward matter for the child to add more pictures in the case of addition, cross off a few if the number is to be reduced, or arrange his pictures in small number groups for multiplication. He cannot, however, share merely by drawing. Suppose, for instance, the child is asked to put 10 eggs into 2 baskets and give the number in each. He can draw the baskets, but he can dispose only of his 10 eggs by drawing one at a time in each basket, which is precisely what we do not wish him to do. One method of overcoming the difficulty is to give him a narrow strip of paper on which he draws the 10 eggs and then cuts them up into ones. He then shares them between the two baskets in the way he has been taught. When this is done correctly, the eggs can be pasted in position if a permanent record is required.

When a child has mastered the practical steps of the four rules to 10, the point is reached at which he needs to be able to disentangle the sum from the story. As has already been indicated, this is the real point of difficulty in working problems. Many experiments have been tried to discover whether some bridge could be built which would lead from the earlier drawing activities to the actual working of problems. What seemed to be needed was some activity which would help the child to read the problem carefully and intelligently so that he could form a mental picture of the number situation involved in it, and yet leave him free to decide upon and carry out for himself the operation necessary for solving the problem. The apparatus suggested here is the result of these experiments. Sets of cards, six in a set, are prepared, each of a size not less than 16×8 in.

and having outline drawings of bags, plates, sheds, &c. Each card and its accompanying packet of 10 small pictures of apples, potatoes, cows, &c., can be used for all four rules. It is found that six different cards will probably provide sufficient variety for the length of time the children are likely to feel the need of them.

At first the problems are written on the board, and practice is given in working each rule. It is pointed out to the children that, by reading their sums carefully, they will find out what to do with the apparatus. For this stage it is necessary to give each child in the group the same number card. Four examples are given to show the type of sum which can be worked with Card 2.

ADDITION

Put 6 sweets in one jar, 4 sweets in another jar. How many sweets in both jars?

The child puts out his sweets as directed, adds them together, and makes a sum:

$$6+4 = 10$$

10 sweets.

SUBTRACTION

There are 9 sweets in a jar. I take out 6 sweets. How many sweets left in the jar?

$$9-6 = 3$$

3 sweets.

MULTIPLICATION

I put 2 sweets in each of 5 bags. How many sweets in all the bags? The child puts out 2 sweets 5 times, writes the sum $5 \times 2 =$ and counts in twos to obtain his answer. Counting in ones should be discouraged at this stage.

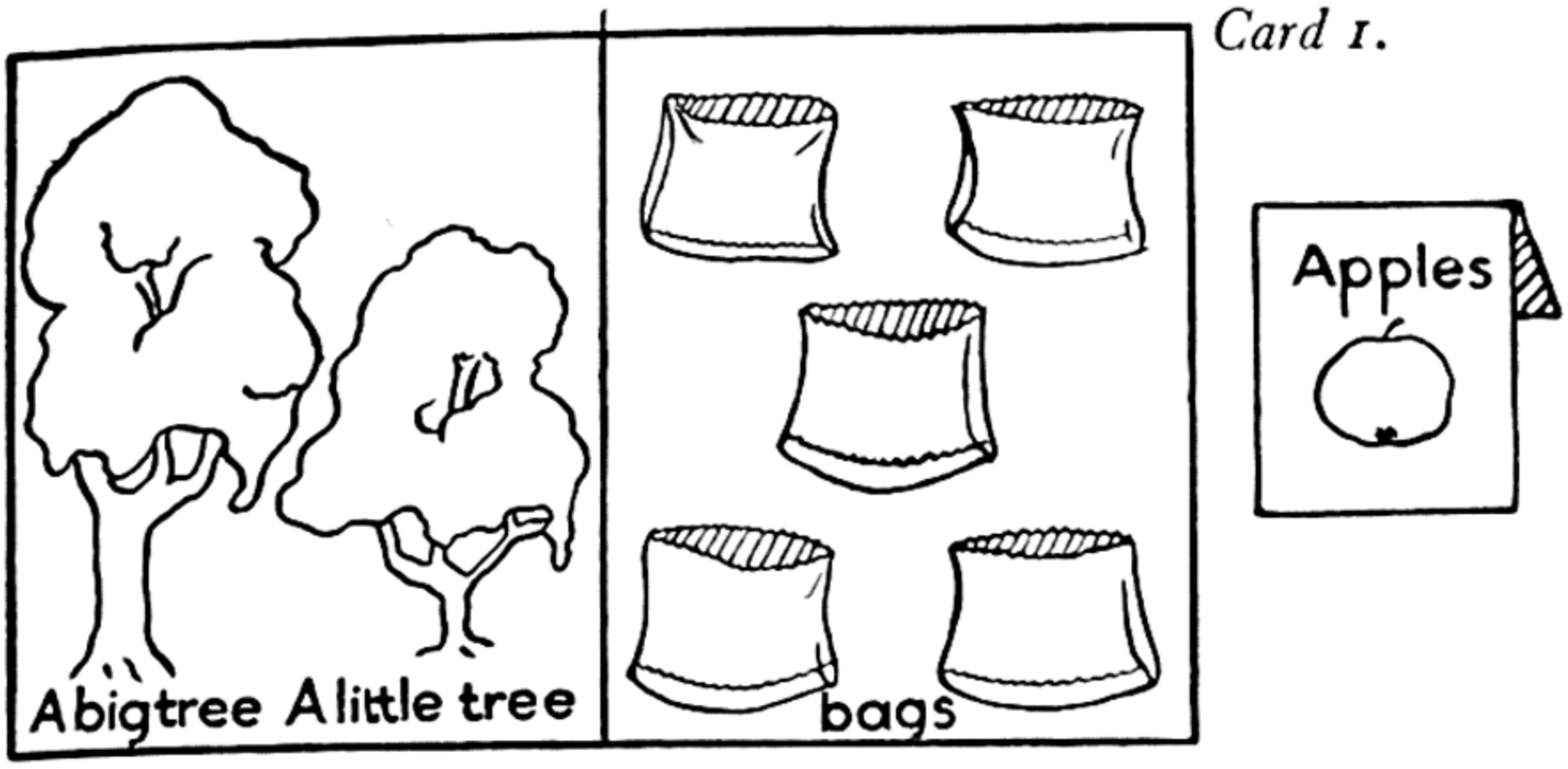
Answer: $5 \times 2 = 10$

10 sweets.

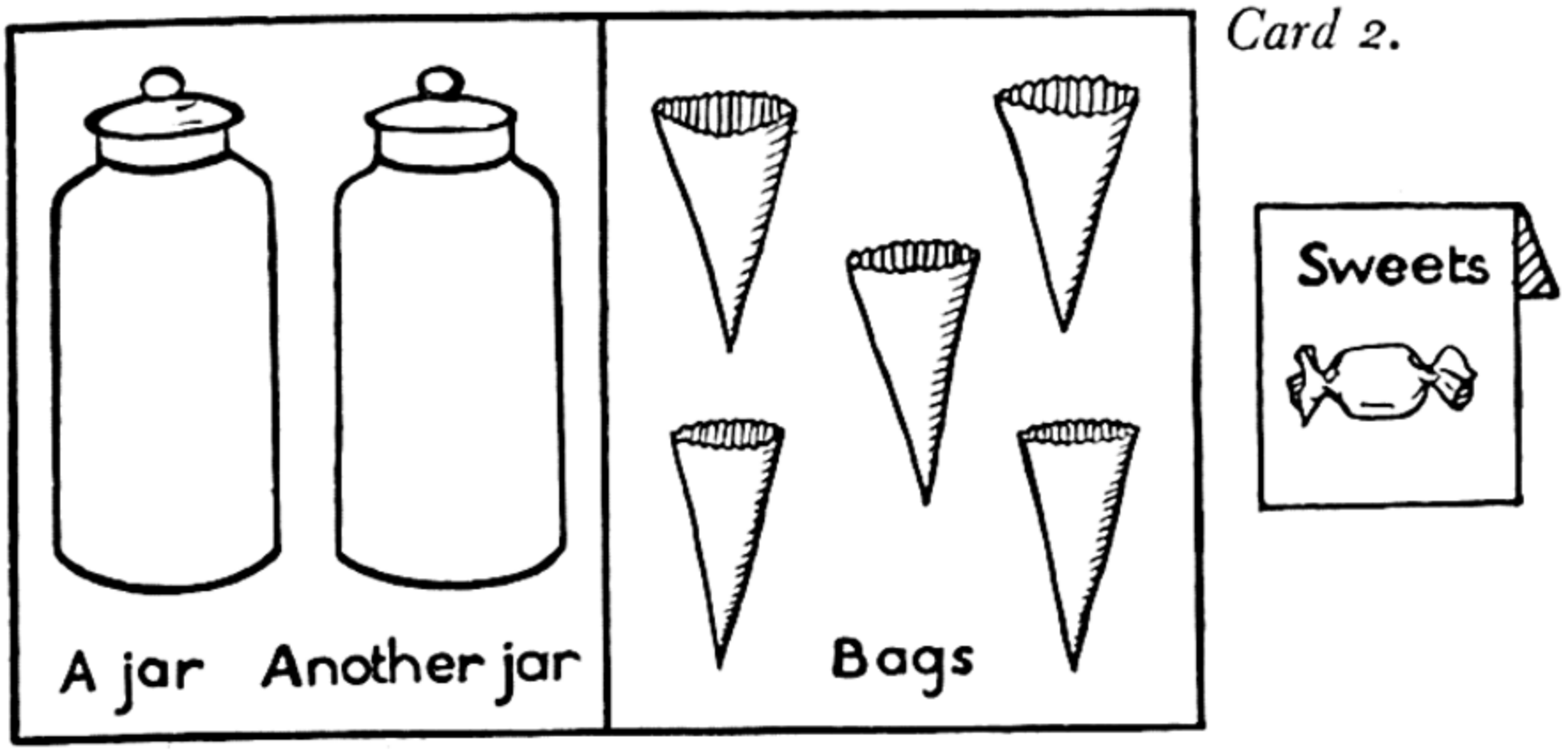
DIVISION

I have 8 sweets. If I put them into 4 bags, how many sweets will be in each bag?

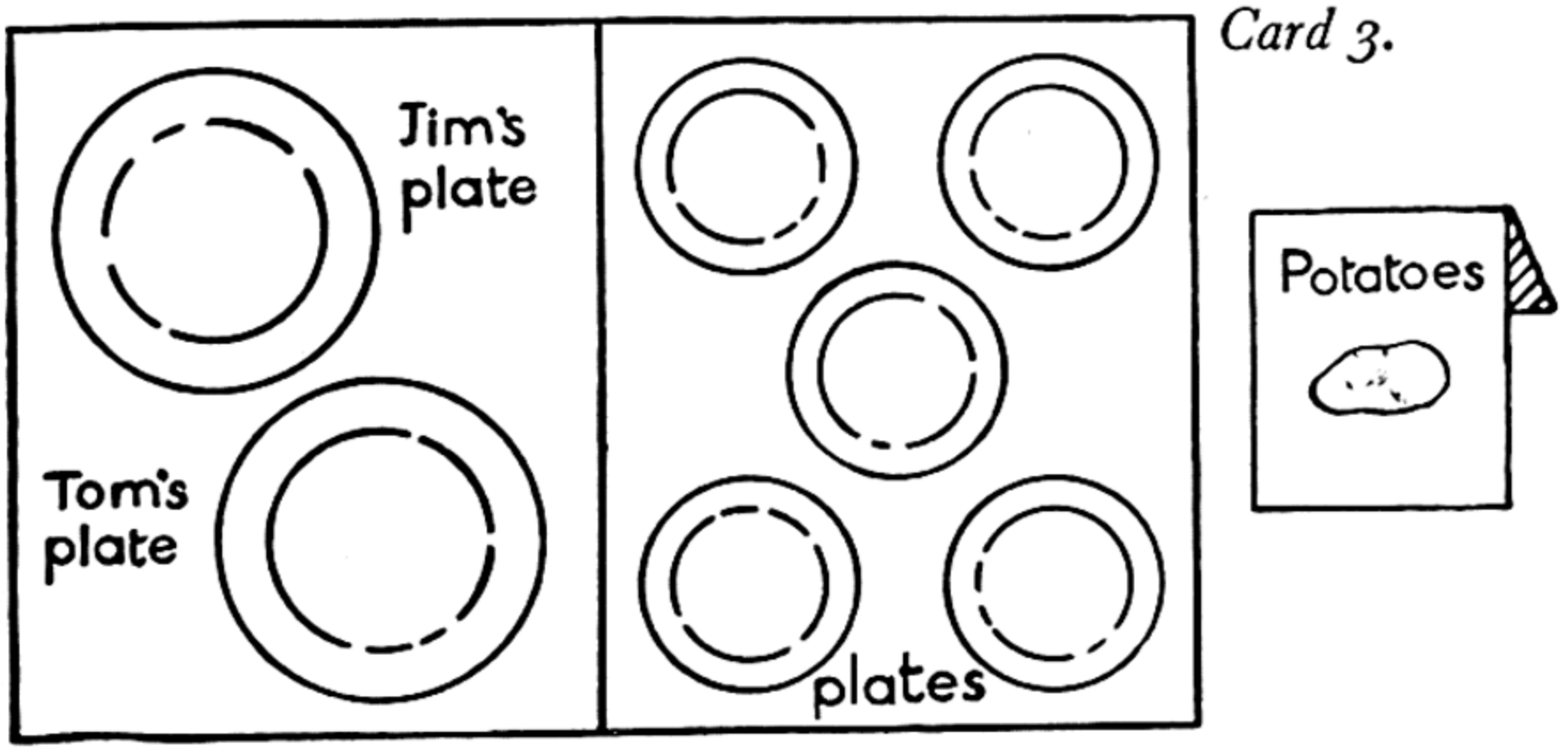
This is the type of sum that presents a difficulty unless the meaning of division or sharing has been made clear. After



Card 1.



Card 2.



Card 3.

FIG. 55

taking 8 sweets from his packet, the child arranges them in groups of 4. He then takes 1 from each group, making 2 in all, which he puts into one bag; then 2 into the second bag, 2 into the third, and 2 into the fourth.

He writes:

$$8 \div 4 = 2$$

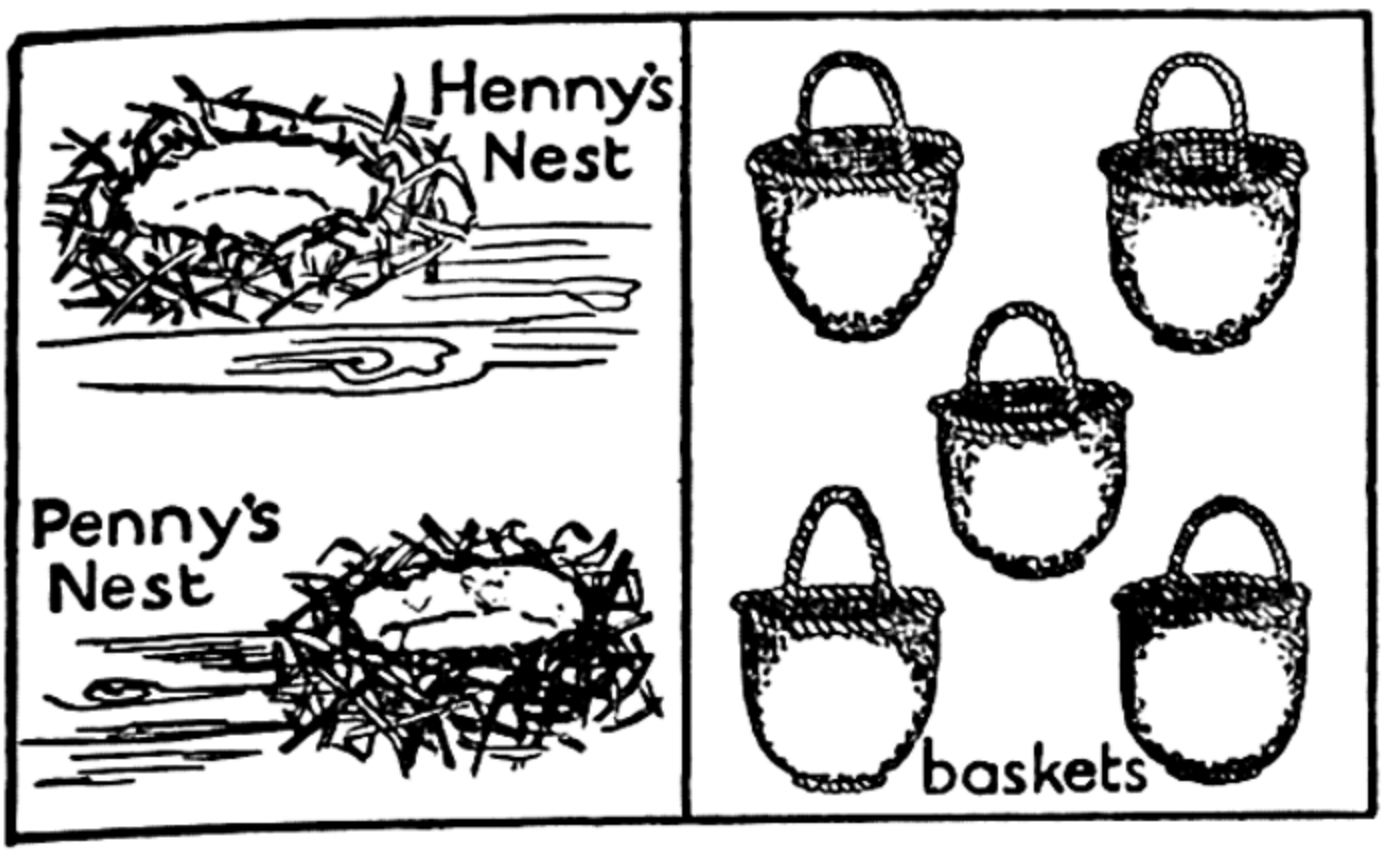
2 sweets.

Any child whose number ability is in advance of his reading is given help with new and different words. It is found, however, that most children soon become accustomed to the sight of such words as 'how many', 'altogether', 'each', &c. The words 'basket', 'field', 'shed', &c., are printed on the cards, and a picture and its name indicating the contents are put on the outside of each smaller packet.

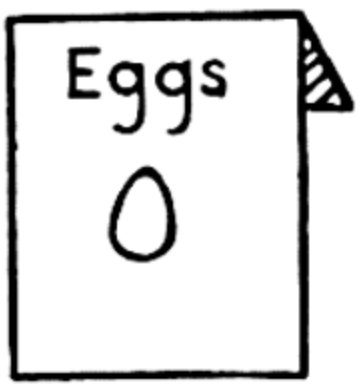
When once the method of procedure is fully understood, and as the child's skill in reading increases, he learns to work from individual cards. The following is the order in which the rules are treated.

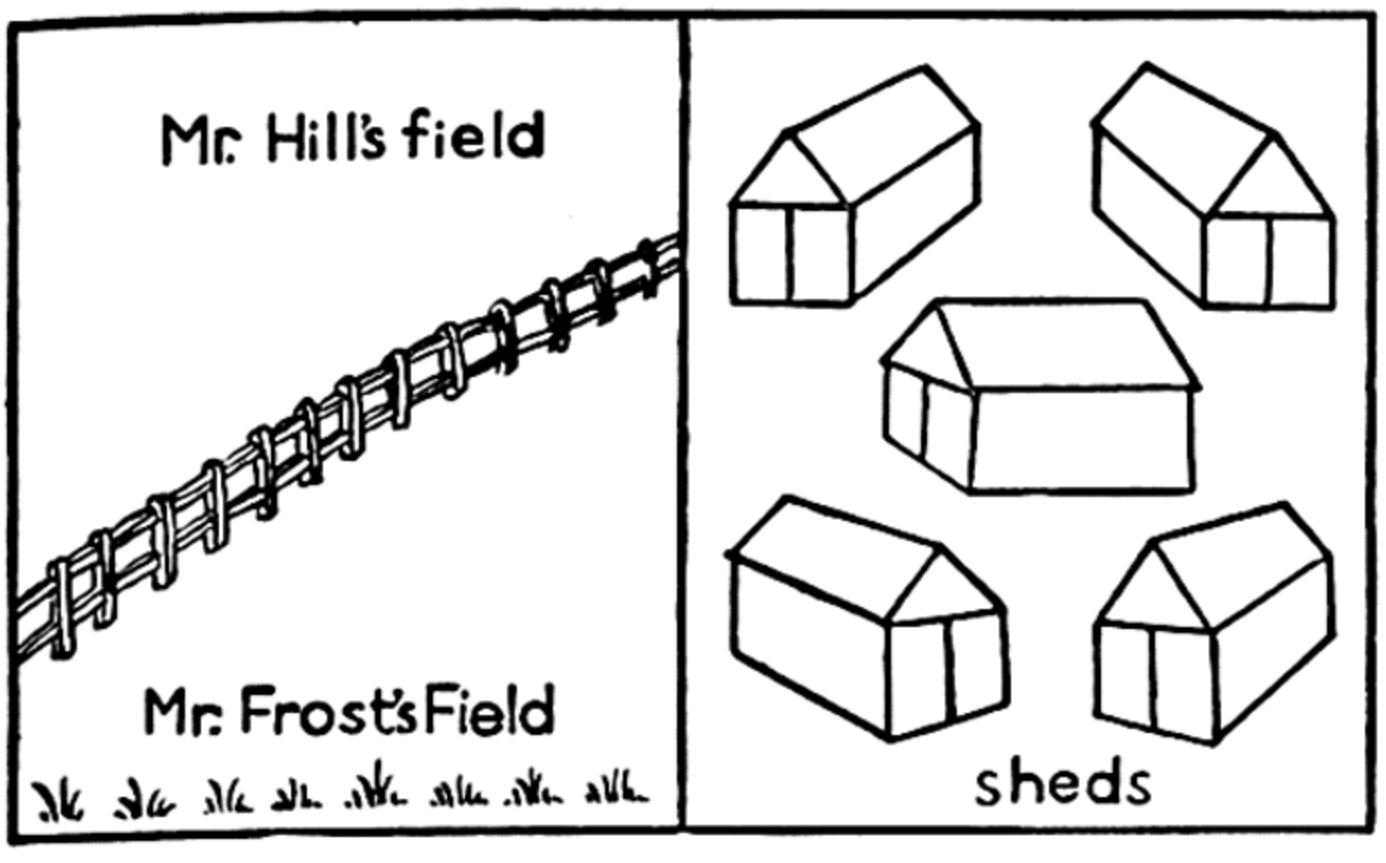
(1) Addition and Subtraction on one card.
(2) Multiplication.
(3) Addition, Subtraction, Multiplication.
(4) Division.
(5) Four Rules.

The child first works the cards using apparatus and as a later step without apparatus. When he is able to do this without difficulty, he is ready to work problems introducing a variety of topics. These should deal with matters relating to school, home, and his immediate experience. While the child is working problems on number to 12 without the use of apparatus, he will be learning the mechanical operation of the four rules to 20 and then 24. As he acquires skill in dealing with these higher numbers, they are gradually introduced into the problems, until finally he is able to work with confidence and intelligence problems involving the use of the four rules to 20. This method of dovetailing the mechanical work into that of problems is not easy to organize, but it is a great help to the child in the long run. For obvious reasons the mechanical

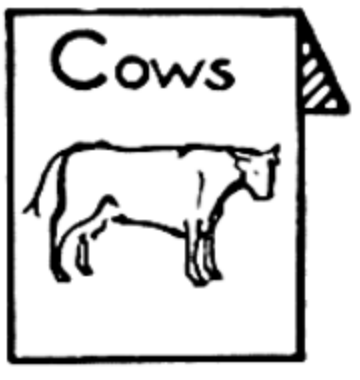


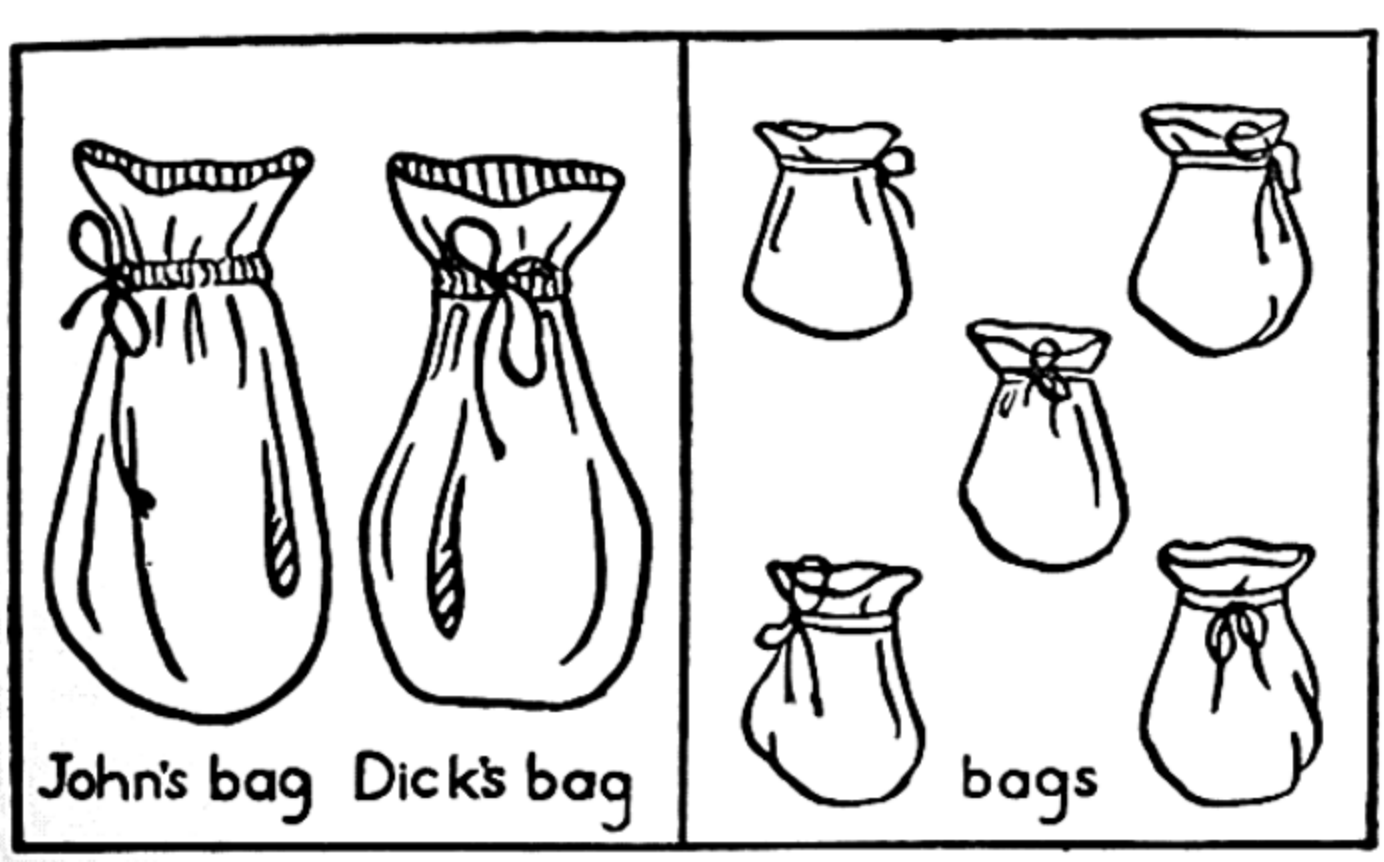
Card 4.





Card 5.





Card 6.

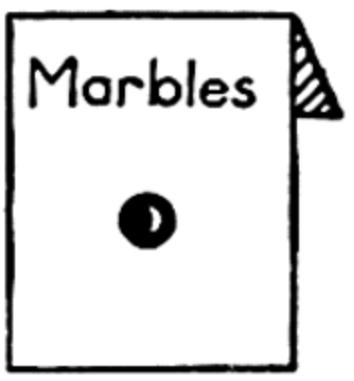


FIG. 56

work must be kept ahead. The same rule applies to the introduction of money into problems. A glance at the detailed scheme given later in the book shows that the child begins work on money to 2/-, when he has worked through the four rules to 20. Thus by the time he reaches the end of the scheme the child of average ability is able to work problems on the four rules to 20 and money to 2/-.

The plan given below should help to make clear the dovetailing system:

Problems	*Mechanical*
1. Four rules to 12.	1. Addition and Subtraction to 20.
2. + and − to 20. × and ÷ to 12.	2. Multiplication and Division to 20.
3. Four rules to 20.	3. Addition and Subtraction of money to 2/-.
4. Four rules to 20 and Addition and Subtraction of money to 2/-.	4. Multiplication and Division of money to 2/-.
5. Four rules to 20. Four rules to 2/-.	

Here is a typical problem card to be given to a child who has reached step 5.

1. Betty threaded 9 red beads and 7 yellow beads. How many beads did she thread?
2. Jack went to the Post Office and bought 6 stamps at 2½*d.* each. How much did he pay?
3. I have 1*s.* 3*d.* in my purse. If I buy a book for 9*d.*, how much shall I have left?
4. Mother made 14 buns. We had 5 for tea. How many buns are left?
5. How many tops at 2*d.* each can I buy for 1*s.* 6*d.*?

A child who is able to tackle with success a card like this has not only mastered the four rules to 20 or to 2/- but is able to apply his knowledge to the ordinary situations of life. His skill, therefore, is a matter of developing intelligence and reasoning power, not mere mechanical memorization. He has all the right foundations for further progress.

Additional experience in problems will arise out of the demands made by the child's practical work in shopping, weighing, and measuring, when he makes a written record of results, either in the form of a logical statement or a conventional sum.

VIII

PLANNING THE COURSE OF WORK

WHERE a variety of activity is introduced into a number scheme, there is always a danger of confusion and waste of time. Usually this occurs where teachers are not clear as to the purpose and value to the children of self-initiated and directed activities. Children who are given opportunities for purposeful activities do indeed benefit, but the results are general. On the whole such children show more initiative and have a more alert attitude to learning. They tend to express themselves clearly and to be able to think things out. They develop a measure of self-control and confidence in their own abilities, and they usually are found to concentrate well. These are qualities vital to future development. Through experiment, children will discover for themselves a good many number facts, and it is from such experiments, together with a certain amount of activity directed by the teacher, that children achieve mastery of number.

Progress in the learning of number takes place when child-initiated activities are combined and extended by teacher-directed ones. Thus, time for number play and free experiment, periods of directed activities, and class instruction all have their place in a well-balanced scheme of number teaching.

The function of a number scheme is not to impose an arbitrary system upon the children, but to provide a clear framework for the teacher. If the teacher has not herself fully worked out the development of number facts, confusion arises. If the teacher knows what fact must next be known before a new development in play can take place, she will be able to use the children's current interests as a basis for introducing the new facts.

The plan of work on which this book is based is really a set of related schemes. It was found necessary to work out the sequence of basic number facts, and these are tabulated on the chart in the column headed 'Number Development'. Parallel to this a development of activities is outlined. Actually only Money and Problem schemes have been worked out in detail, while Length, Weight, Capacity, and Time are used for supplementary experiences. It will be seen that such a scheme allows for almost unlimited variation. One school may decide to concentrate entirely on learning through shopping activities, in which case they will work out the scheme of Number Development in terms of practical experience in connexion with a variety of shops, through play with money, measuring, and weighing out. Another school may prefer to develop one activity at a time, centering number teaching around Weight or Length for a period of time and then passing on to another interest. The Number Development Scheme will have to be worked out in terms of the changing activities. Some people may find it easier to let the children follow the Number Development Scheme, using activities to supply real life illustrations.

The scheme is also divided horizontally into four sections. These divisions are in the nature of a check. While it is possible that some schools may prefer to explore one or more activities fully, there is a good deal to be said for levelling up the work from time to time; and this is particularly true for teachers who are not accustomed to working on these lines. It is suggested that one or more activities of the Number Development Scheme shall be taken as far as the end of a section, and then time shall be given for practice and consolidation in some other form. In this way the teacher can see that the children have covered the ground and that the facts have been well assimilated.

The idea of setting to work forty or more children on individual or group activities seems formidable even to the most experienced teacher. It is a task, however, that must be faced, otherwise it will be impossible to give the children the right kind of practical training and to allow for their greatly varying

NUMBER SCHEME

NUMBER DEVELOPMENT	ACTIVITIES					NUMBER GAMES	PROBLEMS
	Money	*Length*	*Weight*	*Capacity*	*Time*		
Preliminary activities in Nursery and Reception Class, Incidental interest in numbers arising from:							
Rhymes and games	Free shopping play	Toys for sorting, grading, and matching of length and height	Experiments in lifting, carrying, balance Play with scales	Play with sand and water	Play with clock		
A. NUMBERS TO 6 1. *Counting, Values, and Figures to 6* Rhymes, sorting packets, &c. 2. *Addition to 6* Number games, equation building, picture sums	A. PREPARATORY ACTIVITIES Shopping with pennies, price tickets	Measuring activities introduced				Played with increasing skill throughout course: Skittles Number tops Dominoes Bead-threading Tunnel ball Bus rides Fish-ponds Snap	
B. NUMBERS TO 10 AND 12 1. *Counting, Figures, and Values to 10 and 12* Rhymes, sorting packets, &c. 2. *Addition and Subtraction to 10 and 12* Number games Picture addition and subtraction 3. *Counting in Groups to 10 and 12* Rhymes Classroom games	B. MONEY TO 1/- 1. *Pence only* Shopping Money-changing cards Picture addition and subtraction 2. *Halfpence* Shopping Money-changing cards Practice cards: Addition Subtraction Mixed sums	1. Measuring and selling of 'pennyworths' 2. Measuring in feet and inches 3. Measuring in yards	1. Weighing and selling of 'pennyworths' 2. Weighing in ounces 3. Weighing in pounds	1. Measuring and selling of 'pennyworths' 2. Measuring in pints 3. Measuring in half-pints	1. Hours 2. Counting in hours 3. Half-hours		
C. NUMBERS TO 20 AND 24 1. *Counting, Figures, and Values to 20 and 24* Rhymes Classroom games 'Meaning of teen' 2. *Addition and Subtraction to 20* Number games Practice cards: Addition to 20 Subtraction to 20 Mixed sums 3. *Counting in Groups to 24, Multiplication and Division to 20* Number games Practice cards: Multiplication to 20 Division to 20 Mixed sums 4. *Four Rules to 24* Number games Practice cards: Addition to 24 Subtraction to 24 Mixed sums Multiplication to 24 Division to 24 Mixed sums	C. MONEY TO 1s. 6d. Shopping Money-changing cards Shop-windows: Addition and Subtraction Direction cards: Multiplication and Division Practice cards: Addition to 1s. 6d. Subtraction to 1s. 6d. Mixed sums Multiplication to 1s. 6d. Division to 1s. 6d. Mixed sums D. MONEY TO 2/- Shopping Money-changing cards Shop-windows: Addition and Subtraction Direction cards: Multiplication and Division Practice cards: Addition to 2/- Subtraction to 2/- Mixed sums Multiplication to 2/- Division to 2/- Mixed sums	4. Measuring in half-yards 5. Measuring in half-inches 6. Measuring in quarter-inches	4. Weighing with half-pound weights 5. Weighing with quarter-pound weights	4. Use of quart 5. Use of gill	4. Quarter-to and quarter-past 5. Counting in 5 mins. to and past 6. Counting in 5 mins. round the clock		C. *Four rules to 10 and 12* *Money to 1/-* Problem cards D. *Addition and Subtraction to 20* *Money to 1s. 6d.* Problem cards E. *Four rules to 24* *Money to 2/-* Problem cards

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rates of progress. The problem of controlling a large class, while at the same time providing every child with sufficient work to suit his ability and of seeing that he does it, can be made far less terrifying than it sounds. It is, of course, a problem that can only be solved by the individual teacher or school concerned. The most we can do here is to make a few suggestions for dealing successfully with the various problems of class organization and discipline and for creating the right atmosphere in which a child can do his best.

From the start no pains must be spared to make the children like arithmetic. This is easy enough with clever children. To them number presents a fascinating game of solving puzzles, and they will seem to be just as happy and absorbed in working a practice card as in weighing make-believe sweets at the school shop. This is not true of slow children who are mentally, and quite often physically, incapable of giving the amount of effort and concentration the subject demands. Unless something is done for them their number lessons will become a succession of depressing experiences, resulting in a definite dislike for anything concerned with figures. The teaching of number to a class of varying ability, therefore, requires careful and judicious handling if all, instead of the gifted few, are to share in the enjoyment which the lessons should bring.

We will begin with a class of new-comers making their start on number work. As most teachers of these classes are fully aware, any organized work is out of the question until the interest and co-operation of the children has been secured. For these early lessons the teacher can do little more than gather her children together and play a few simple games with them, say or sing number rhymes, or introduce them to counting in a fascinating way through clapping, hopping, &c. Some children will prefer to watch at first, and this should be allowed. They will find, sooner or later, that it is more fun to join in, and then they will do so. As the children become more sure of themselves, the teacher is able to plan these play lessons in number with a definite aim in view.

So far the difficulty of catering for the inequality of ability does not arise. As time goes on, however, differences in rates

of progress begin to show, and some form of grading becomes necessary. The mentally alert children are put into Group A. Those who are slow and cannot quite keep the pace of the A's form Group B; and the C group is made up of the dull and backward children with the addition of a few starters at school. For the most part the A's and B's can be taught as groups, but the C's call for more individual treatment. For activity lessons the class is divided into four groups which, in the early stages, need not be according to ability. With the help of a detailed scheme and by keeping a record of progress, the teacher can make certain that each child, whether taught individually or as one of a group, masters one step before proceeding to the next. This does not mean that a child is expected to work at one particular rule, say addition, day in and day out, until he is able to present a page of correctly worked sums. If a child is to enjoy a real sense of number, he must see the need for addition and be helped to realize its relationship with other rules. He can best do this through shopping experiences, games, and the working of simple problems, so all these are included in the planning of each week's activities. This method of varying the type of number lesson from day to day not only sustains interest but enables the child to keep within sight, as it were, each step of his number work. It also helps to counteract the unfortunate habit of young children of forgetting one rule while learning another which, if not provided for, causes unnecessary halts in the child's rate of progress.

While the actual planning of the work must remain the responsibility of the individual teacher, it might be helpful to give a few suggestions as to the proportion of time allotted to the different activities. Not less than $2\frac{1}{2}$ hours per week, divided into five daily half-hour lessons, is considered a reasonable amount of time to spend in definite number teaching. This, of course, includes the giving out and putting away of apparatus, books, &c. One hour per week is spent by each child on the more formal side of the work, which includes the working of practice cards with or without apparatus, drill in simple number combinations, and the learning of number rhymes for group counting. Of the remaining three half-hours,

one is given to shopping activities, one to problems, and one to games or revision of rules previously taken. Class lessons are not ruled out entirely. They are taken at the discretion of the teacher whenever she feels that they will help the class as a whole. For instance, lessons on time are taken collectively. Certain games and activities require more explanation than others, and in these cases it may be more satisfactory to give a demonstration to the whole class, than to put a few on the right track and leave the rest to flounder their way through when their turn comes to play the game.

It might be thought that, as the children progress through the school, and arithmetic of a more formal nature is gradually introduced, the need for elaborate preparation will grow less. This might be so if children all progressed at the same rate. Group activities should continue, and sufficient exercises be provided to allow each child to work up to but not beyond the limits of his ability. Much of the success of the work will depend upon the ability of the teacher to plan well beforehand. Each day's number lesson should be systematically thought out, a written record made; and above all, the teacher must know what each child is to do and why.

IX

SHOPS AND HOW TO MAKE THEM

It has been shown in an earlier chapter how a simply made shop can provide the children with a very satisfactory amount of practical experience of the use of number in a purposeful way. Very soon, however, teachers and children will feel that something more like a real shop is needed, not only to sustain the children's interest, but as a means of widening their knowledge of the commodities to be found in the various shops to which they are likely to be sent. These include the baker, grocer, sweet shop, toy shop, greengrocer, and the general stores or bazaar. One way of furnishing a shop is by collecting empty cartons and dummy packets from shopkeepers, and with

here a most realistic display can be made. But the children soon discover that these shops are not real at all. Real shopping in the literal sense cannot really be carried out in school. The show-packets are, of course, empty or stuffed with paper, and so the child gets a false idea of weight. It is important, therefore, if a dummy shop is to be used, that the question of true weight be borne in mind.

Children undoubtedly find their greatest delight in shopping at those shops which they have made themselves. By the time the teacher and children have decided together what shop or shops are to be made and discovered what goods will be needed, the children will be full of suggestions as to ways and means. Children's ideas, however, are often not practical, and the teacher's part is to use her experience to tell what can and what cannot be successfully attempted. She will be able to help the children with their experiments and make stimulating suggestions herself better if she has behind her a background of other people's experience. It is with this purpose that the following descriptions of shops are given.

The methods used in making these shops were evolved by children of a specific age and have proved suitable to the manipulative skill of that age. For instance, the greengrocer's shop was made by five-year-olds, and the vegetables were made by rolling, tearing, cutting, and crushing paper, with some clay modelling and painting. An older class would use more ambitious means. The drapery shop was made by six-year-olds. The more exact folding and cutting needed for frocks and pinafores, &c., was within their powers, and the children were able to use to the full their love of pattern-making. If this shop were made by younger children, the ideas suggested would need to be much simplified. The toy shop was chosen by the oldest children and was found a most economical one to make, as most of the stock can be made from empty cartons and boxes. The greater part of this material was collected by the children themselves. The methods used here call for the greater manipulative skill and ingenuity which can be expected from children of seven. The toy shop also lends itself to correlation with other school subjects. Stories for the story books can be

written in the English lesson and illustrated in the Art lesson. The Art lesson can also be used for the painting of chess and draught boards for the games section of the shop. Periods given to sewing and knitting can well be used for the making of doll's clothes, bags, purses, &c.

There will be times when one class will want to use the shops made by the other classes for their activities, and, unless it is possible to house them all in one place, it will mean an occasional interchange of classroom. Co-operation from the staff on this matter will easily be forthcoming, if everyone realizes how necessary this is to the satisfactory completion of the full scheme.

For these more elaborate shops, the first necessity is a simple structure, not only to give a more realistic effect, but to house and display the large amount of goods which will accumulate as each handwork lesson comes round. Practicability must be the chief consideration in deciding the type of framework. No one wants a cumbersome piece of furniture added to a classroom where, in all probability, floor space is already somewhat limited. Its structure must, therefore, be such that it takes up as little room as possible, that it can easily be moved, and is made to fold flat for storage purposes. These three points were borne in mind in designing the shop shown in Fig. 57 on the next page. It is a three-sided wooden structure and fits round a desk 3 ft. 4 in. in length. There is a space at the back for the shopkeeper. Shelves are fixed on brackets which are made to collapse when not in use. The two ends of the bar, showing the nameplate, are fixed into slots at the top of each front upright and kept in position by means of two brass hooks and eyes. The two sides of the shop are hinged to the back. Goods are displayed on the counter and shelves, so that they and their prices can be easily seen by the customers. For the greengrocer's shop the sides are left uncovered so that the uprights can be used to display rhubarb, celery, packets of seeds, &c., but in the case of the others they are covered with strong brown paper. When the shop is packed away, the top bar is first unhooked and removed, the shelves let down, and the whole structure can then be folded like a clothes-horse.

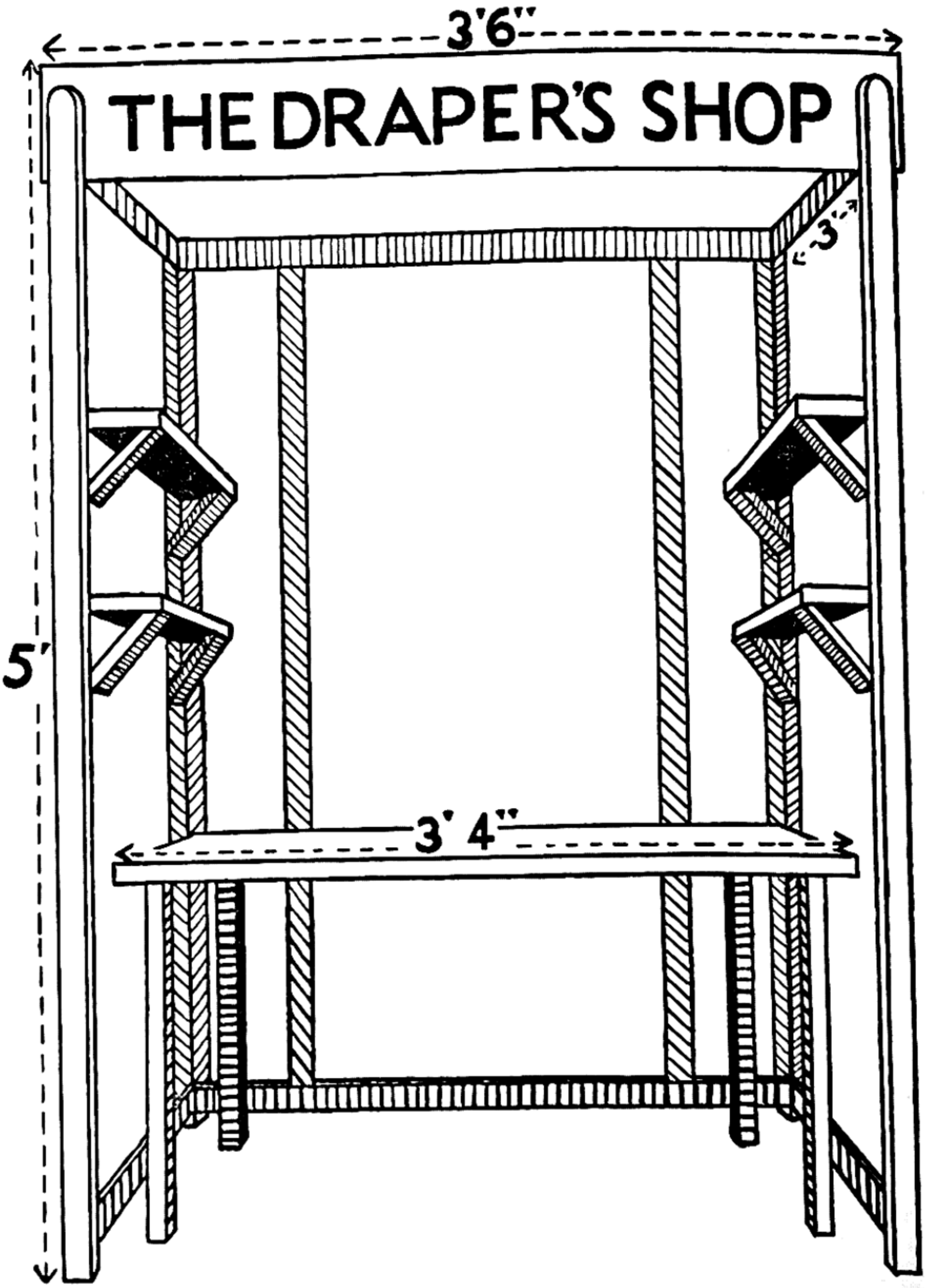


FIG. 57

1. The Greengrocer's Shop

A suggested list is given here from which it is possible to make a selection appropriate to the time of the year. Potatoes, carrots, parsnips, turnips, damsons, pears, apples, oranges, vegetable marrows, cucumbers, peaches, tomatoes, cherries, strawberries are modelled in clay and, when dry, painted with powder colour.

Radishes. Modelled in clay and then painted. A small kindergarten stick and a few green paper leaves are added for the top.

Cauliflower. Ball of newspaper, wrapped in white tissue paper for the heart. Green tissue or crêpe paper for outer leaves.

Cabbages. As for cauliflowers, but the heart is made of pale-green paper and the outer leaves of darker green.

Sprouts. Take a strip of green paper 12×4 in. Fold into eighths. Cut into leaf shape. Open out and fold to form a sprout.

Rhubarb. Roll a sheet of white paper for the stalk, and then paint it pinky-red. Cut out leaves of green crêpe paper and paste to the top.

Celery. Roll a sheet of white paper. Add small leaves of green paper.

Onions. Small balls of newspaper wrapped in suitably coloured tissue paper. Twist at the top.

Seed packets. Make packets by folding an oblong sheet of paper in two. Put a few seeds in each and seal it up. Decorate with pictures cut from old seed packets or gardening catalogues.

Plants in pots. Crushed green paper attached to twigs and placed in cream cartons filled with soil.

Tins of peas, plums, &c. Cut out pictures of fruits or vegetables from coloured paper and stick to sides of tins. Add label.

Simple flower-making.

2. The Draper's Shop

Material. Rolls of cheap wallpaper and kitchen paper make plain materials, such as linen, calico, &c., and unprinted

newspaper stamped with stick printing patterns makes excellent prints, printed linens, &c.

Dresses. Simple Magyar styles, cut from double plain paper and afterwards painted. Children stamp patterns of spots or flowers if desired. They also add their own decorations, collar, belt, buttons, &c.

Pinafores. Cut from paper, pockets and straps added, then painted and decorated.

Collars, bibs, lace, mats, scarves, runners, &c. Cut from paper. Children add their own designs, such as lace edges, coloured borders (stick printing), embroidery (paper cutting).

Gloves. Each hand is cut double and the two pieces fastened together round finger edges. The child draws round his own hand for the shape.

Socks and stockings. Cut from double paper and painted, unless the paper is already coloured.

Buttons. These are cut from coloured paper, the children drawing round various-sized coins. They are then pasted on to cardboard in groups of half-dozen, dozen, &c.

Tea-cosy. Shape cut out double, stuffed and covered with crêpe paper, and trimmed with a bow. An effective result can be obtained by cutting out a cottage-shaped tea-cosy, adding doors, windows, &c., in paper cutting.

3. The Toy Shop

Spinning-top. Cut out a cardboard circle 3 in. in diameter. Cover with coloured paper and decorate with a paper-cutting design. A piece of stick, 3 in. long and sharpened at one end, is passed through the centre.

Necklace. The beads are made from strips of wallpaper, $9 \times 1\frac{1}{2}$ in., tapering to a point at one end. These are rolled on a thin knitting-needle, starting with the wide end. Then they are painted in bright colours and threaded.

A kite. Take two pieces of coloured paper, 8×12 in., and fold them in half. Open the papers and fold as shown in the sketch. Cut along the creases to get the shape of the kite. On one kite paste a strip of cardboard from *A* to *B*

and another from *C* to *D*. Turn over and paste the other kite into position. The tail is made by threading 1-in. squares of coloured paper on a piece of string.

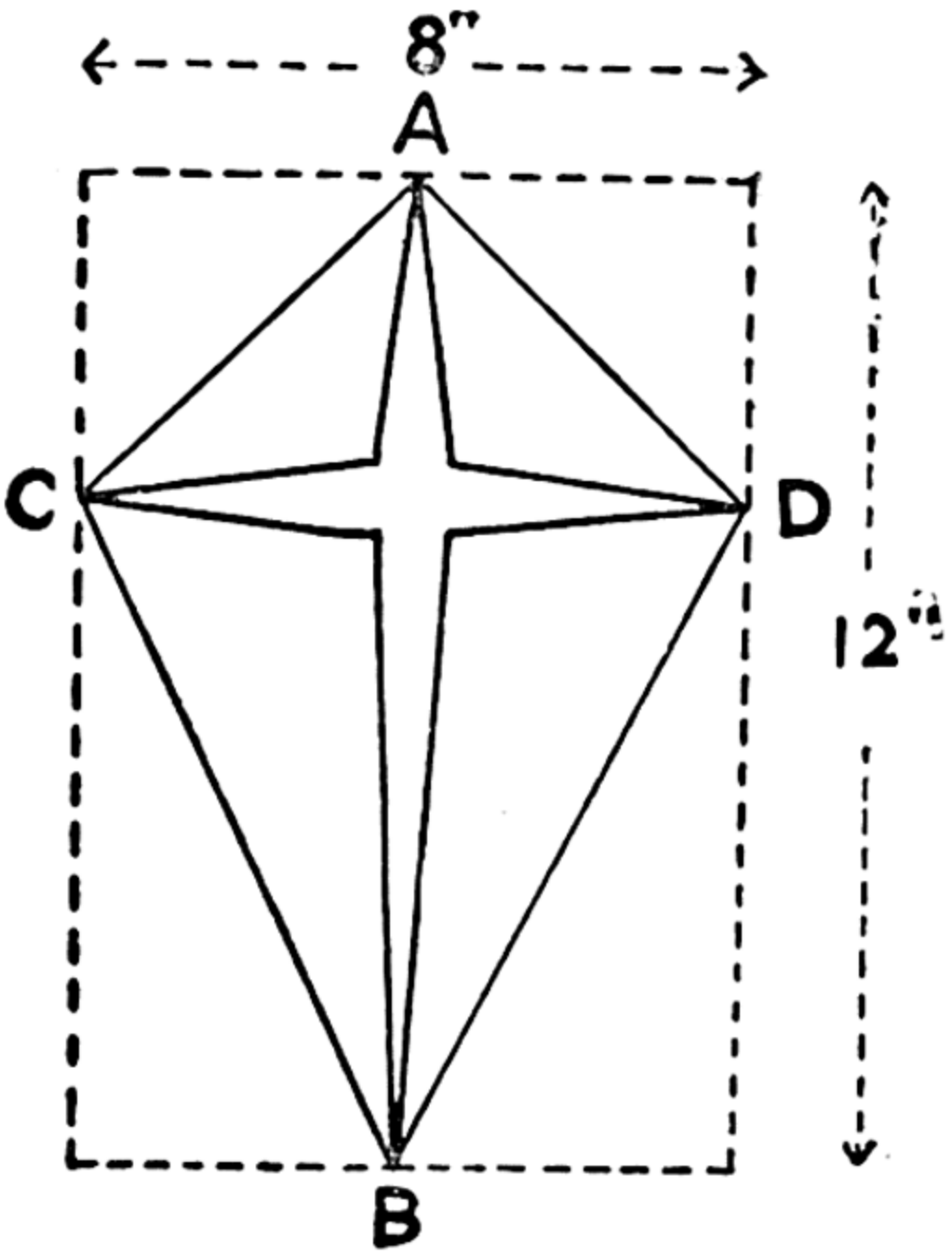


FIG. 58

Flags. These are usually made by the less skilful children. They are cut out in paper and pasted to a small stick. A simple design, such as a cross, is added.

Masks. Made in various designs, animal faces, clowns' faces, &c.

Streamers. This can be an exercise in measurement. Children cut coloured paper into strips 1 in. in width, and then fasten several of them to the top of a stick which has been covered with two colours of paper, like a candy-stick.

Jig-saw puzzles. Discarded Christmas and birthday-cards are used for the pictures. Cut up into pieces, not too small. Make a box from a sheet of paper folded into 16 squares. The lid is made slightly larger. Children carry out their own ideas for decorating the boxes.

A flying bird. This is a fascinating toy and easy for the children to make, if they are given a pattern of the body and wings to draw round. Having cut out the parts, they colour them to their own liking. The wings are attached as shown in the sketch. When the bird is finished, one end of a thin piece of string is fastened to its back and the other end to a stick. (Fig. 59.)

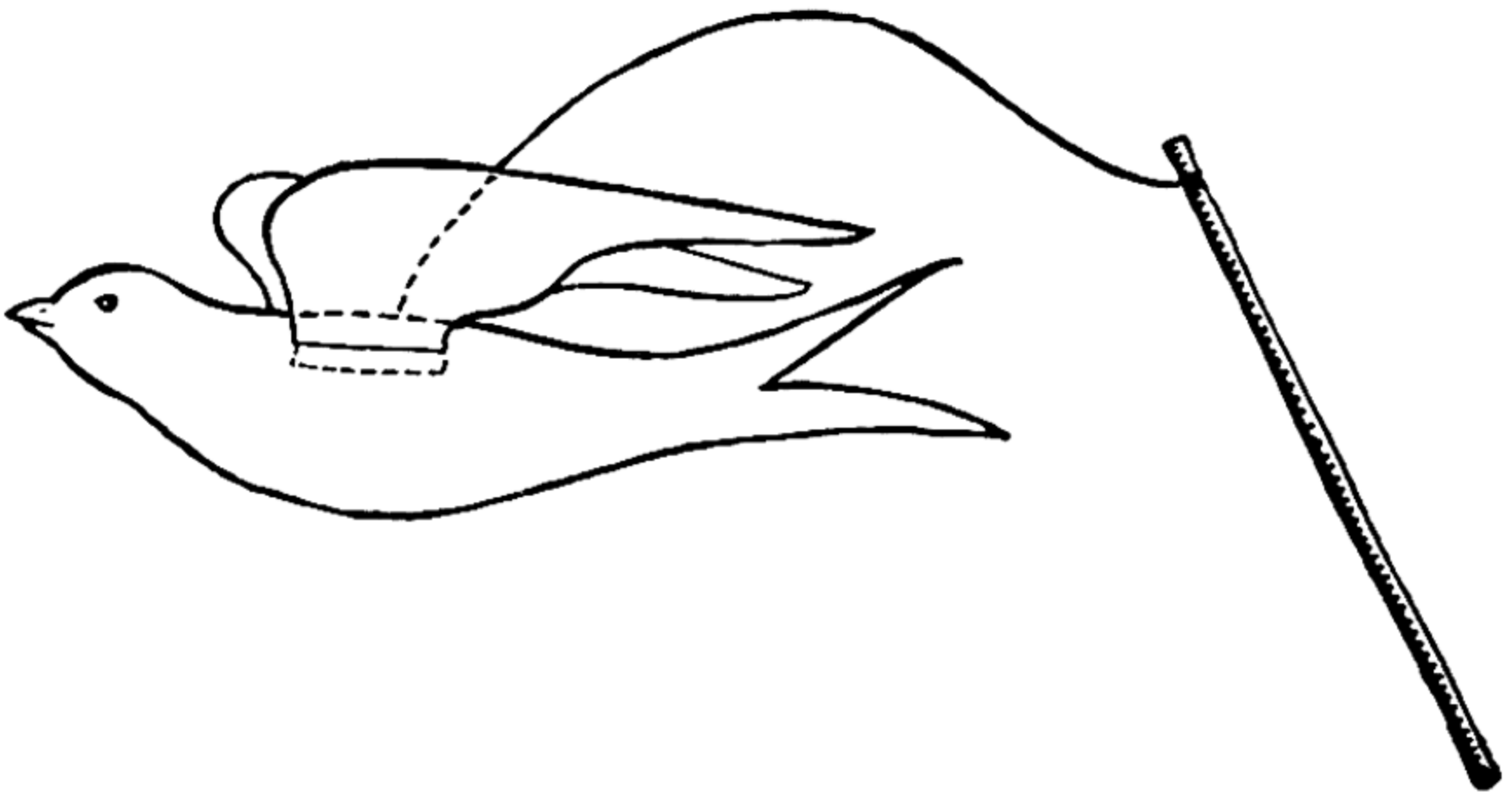


FIG. 59

Baskets. Use the small punnets in which mustard and cress are sold. Attach cardboard handles and paint in two colours for an effective result.

Skittles. Colour clothes-pegs mounted on Gloy bottle corks. A ball is made from clay.

Dolls. Take a small clothes-peg with a flat head. Pass a pink hair-curler through two holes on each side of the body for arms. Paint the face pink and add features in Indian ink. Gum a little crêpe hair to the top of the head. Having made their dollies, the children can be left to dress them according to their own ideas.

Doll's pram. Use a small box about $4 \times 2\frac{1}{2}$ in. for the body. For the hood, fold a 7-in. square of paper into 16 squares. Cut off 8 squares. Cut along folds as shown in Fig. 60. Paste *A* over *B* and *C* over *D* to make a hood shape. Cut out the handles from 2 squares of the remaining piece of

paper, Fig. 61. Paste *E* to one end of the box and slightly bend the top portion. Milk-bottle tops for wheels complete the pram. Clever children might be able to make the wheels turn by inserting thin sticks as axles through them and fastening the sticks to the bottom of the pram.

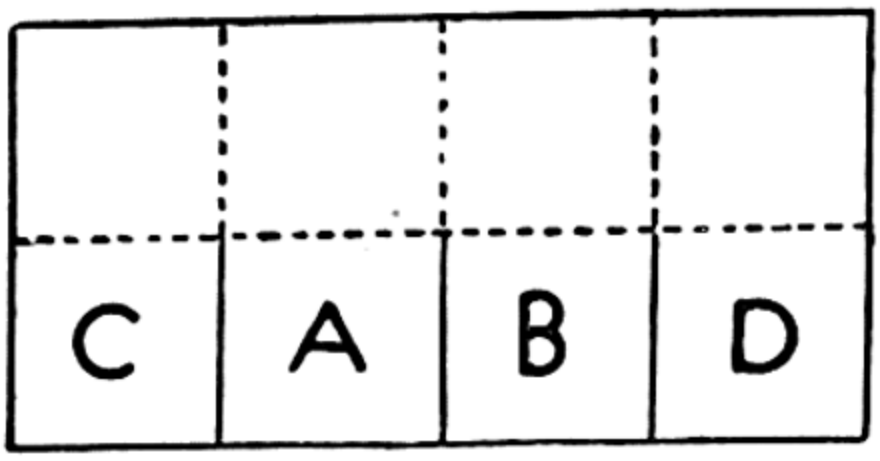


FIG. 60

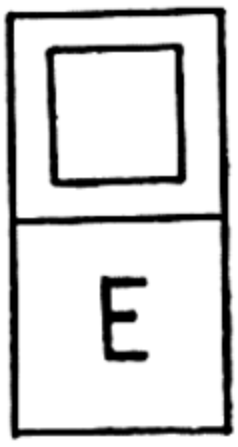


FIG. 61

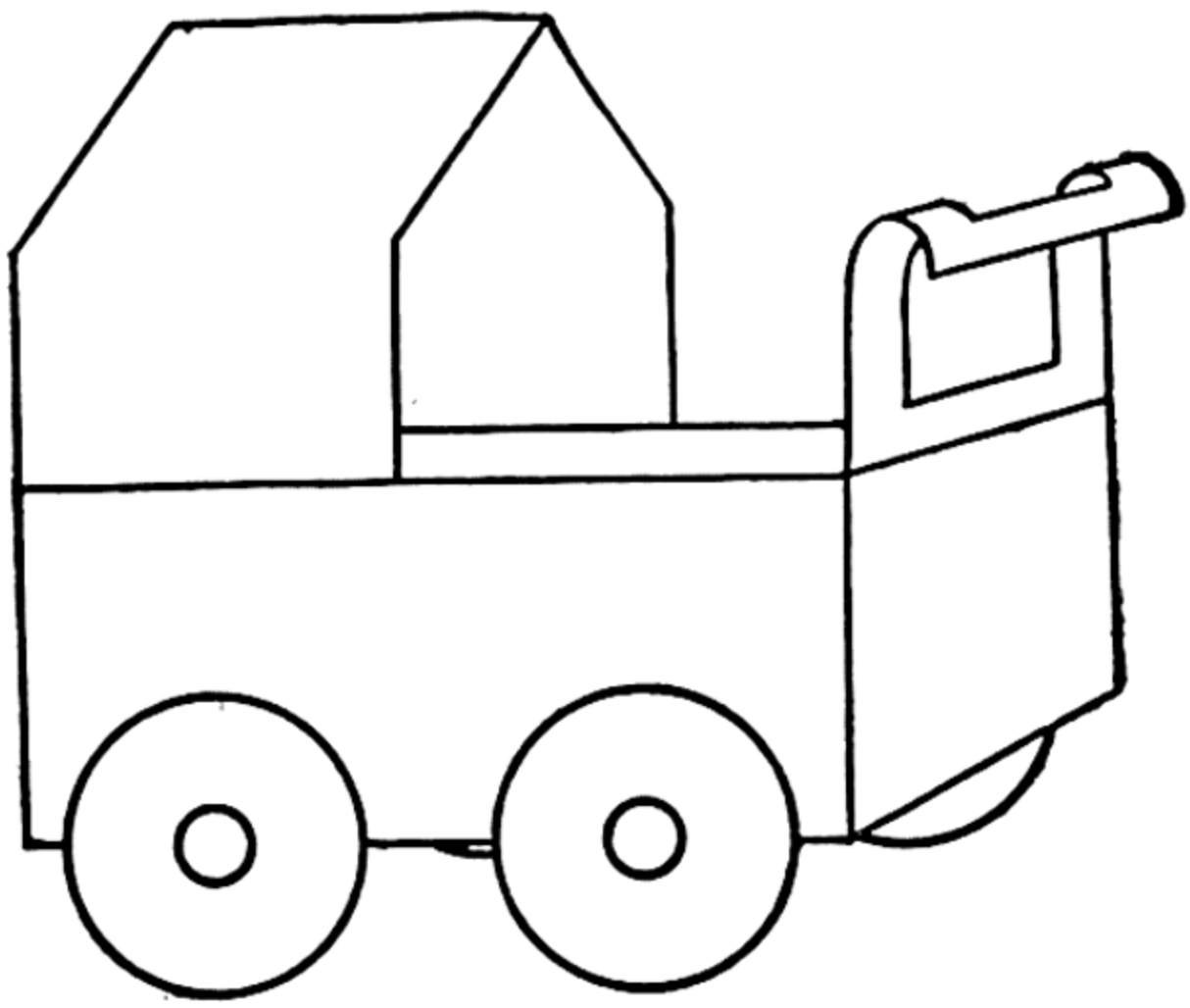


FIG. 62

Skipping-rope. The rope is made in French knitting on a bobbin, with coarse but not too thick string. Paint two clothes-pegs for handles. Attach the ends of the rope securely between the prongs of the peg. Add bells if possible.

Jack-in-the-box. Cut down three sides of a milk-straw box to half. The uncut side, when bent over, makes the lid. Cover with paper and decorate. For Jack's spring, take two strips of paper and fold in 'concertina' fashion. Secure the

two ends. Cut out the upper part of Jack in the cardboard. Use a scrap for his face and dress the rest of him in paper, adding a big bow for effect. Paste him to the spring and he is ready to perform.

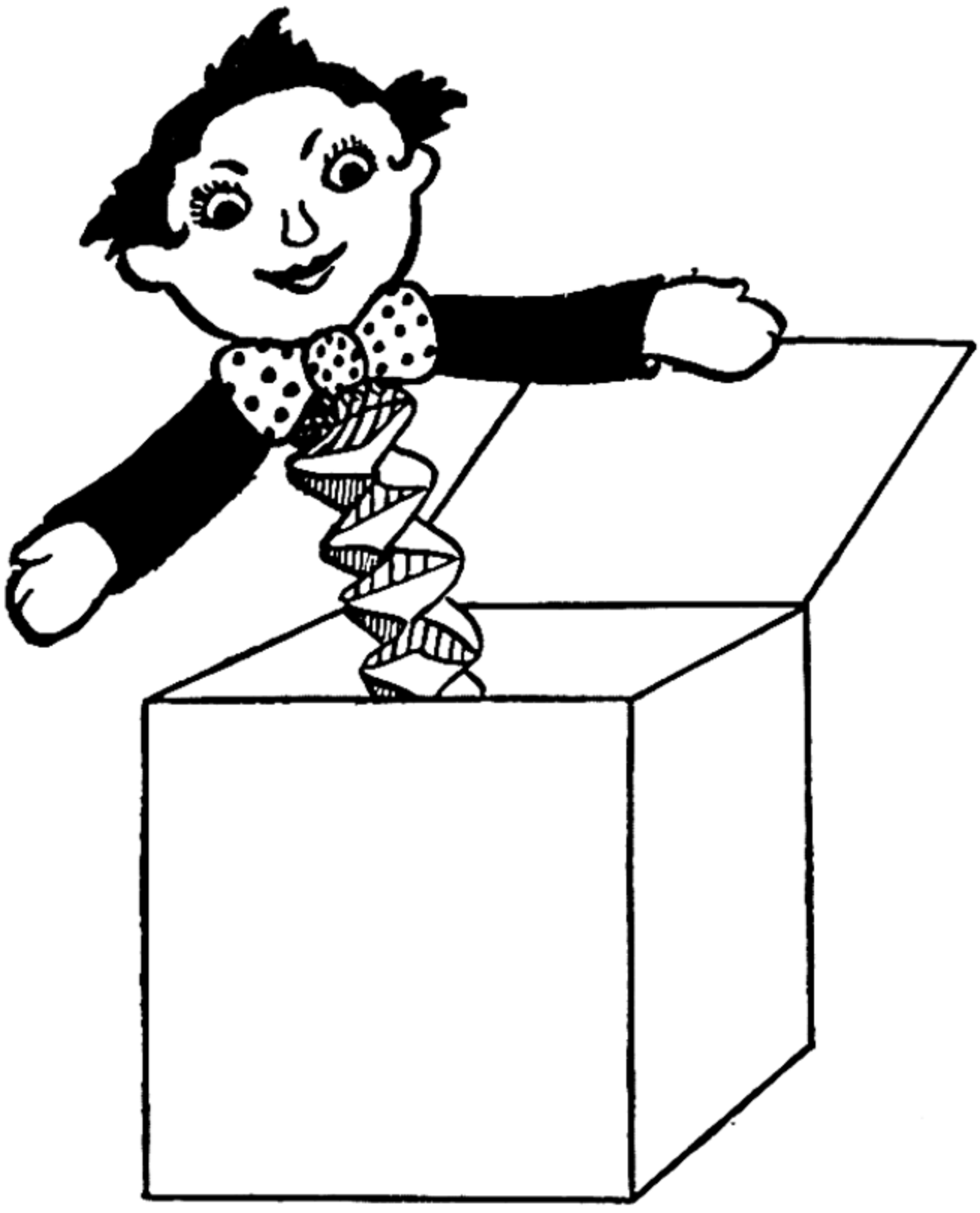
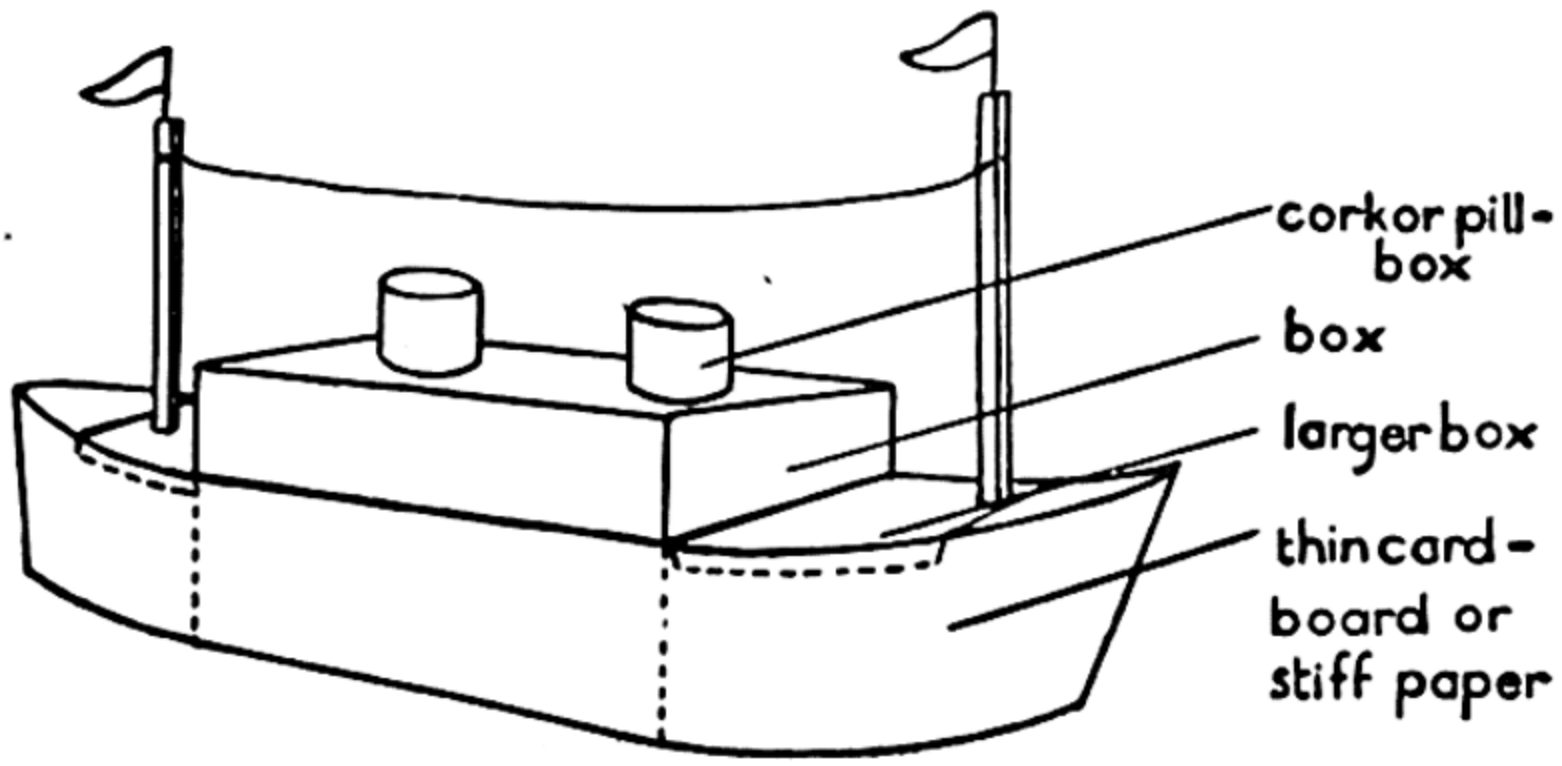
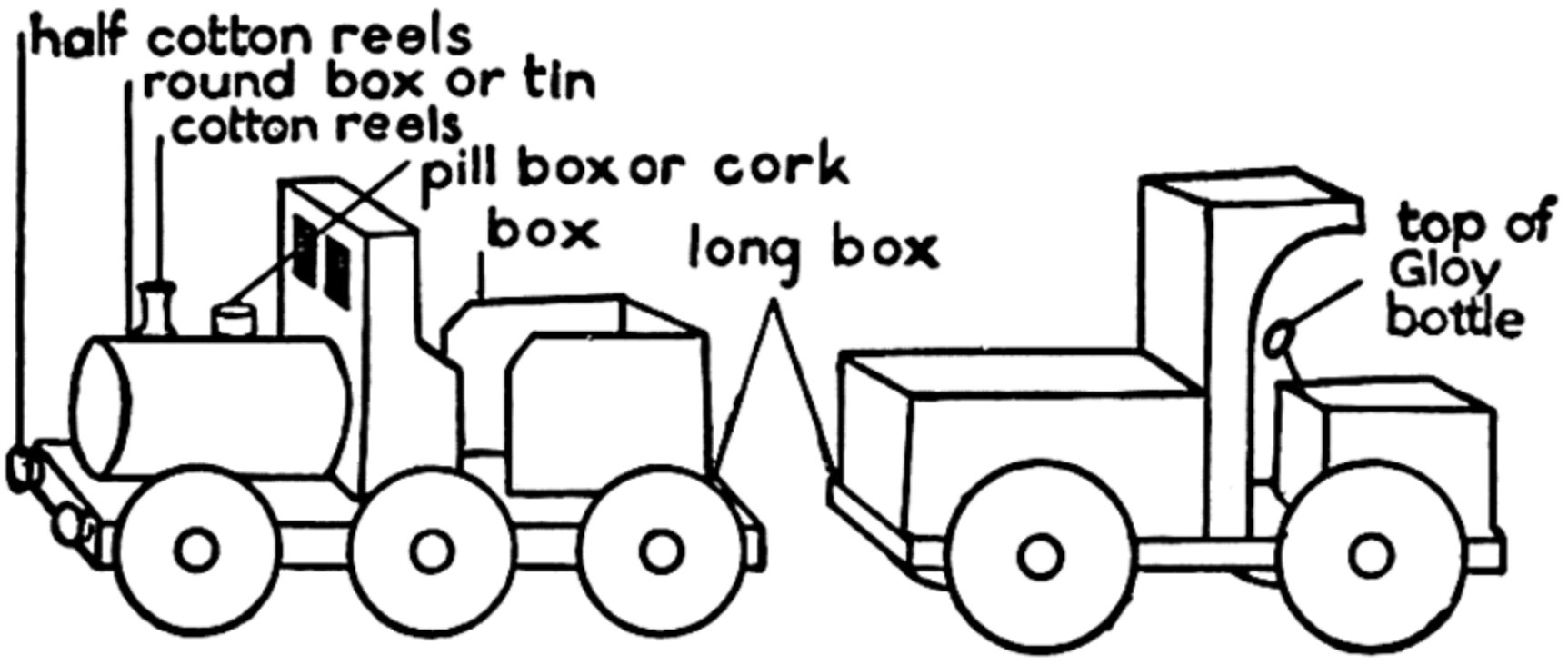


FIG. 63

Boxes of various sizes are used for the foundations of the toys shown in Fig. 64. Cotton-reels and corks can be used for the smaller parts, whilst camera spools make excellent wheels. Unless the toy is to be painted on completion, it is as well to cover each box with paper before assembling. Once started on such toys, children will produce many more and of great variety. In fact a big box containing small boxes, tins, matchboxes, cotton-reels, odd pieces of wood, corks, pieces of cardboard, and coloured paper, with a few hammers, nails, and a little liquid glue, will provide almost unlimited scope for constructiveness and concentration to the boys of a class.


cork or pill-box
box
larger box
thin card-board or stiff paper


half cotton reels
round box or tin
cotton reels
pill box or cork
box
long box
top of Gloy bottle

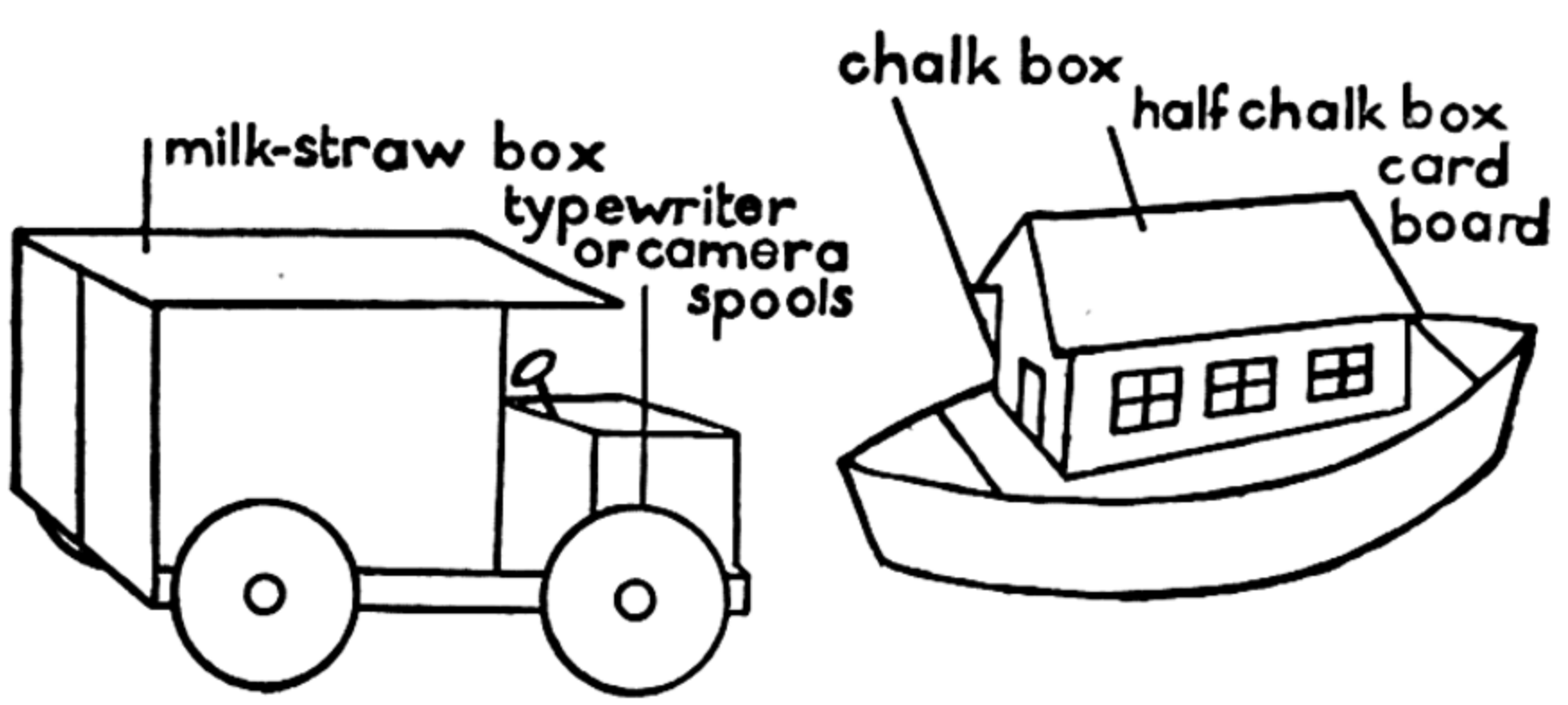

chalk box
half chalk box
card board
milk-straw box
typewriter or camera spools

FIG. 64

BOOKS

Picture-books

(*a*) Pictures are cut out from old books, magazines, &c., and mounted into books.

(*b*) Pictures are drawn and painted in Art lesson. Best attempts sewn together to make a book.

Reading-books. These are made in the English lessons.

(*a*) Each child has a few small pictures, and he writes a sentence about each on strips of paper. Those spelt correctly are pasted, along with their pictures, into a book. When the book is full, the cover is decorated with a paper-cutting design.

(*b*) Each child has one picture, about which he writes a story. After correction he makes a fair copy and pastes that, with its picture, into a book.

(*c*) Children draw and colour their own picture and make up a story about it.

Other types of books which children enjoy making are 'My Book of Animals', 'My Book of Ships', 'My Book of Flowers', &c. Children draw or cut out appropriate pictures and write a short description of each. When put together they make very interesting and attractive little books of which the children can be justly proud.

X

MAKING AND STORING OF APPARATUS

PRACTICALLY all the activities mentioned in the book require apparatus, some of which can be bought. Many teachers feel, however, that they can best meet the need of their children by making their own. Perhaps a word might be said here about home-made apparatus. It is worth spending a little extra time in making apparatus well. It lasts much longer and saves time in the end. It should be large and solid, bright in colour, and of firm material that will not curl or fray with use. Figures, pictures, &c., should stand out clearly from the background. Indian ink is best for lettering. The finished apparatus can be

brushed over with white hard varnish. This adds to its lasting qualities and enables it to be washed when soiled. Care should be taken over the making and spacing of figures. The child looks upon his number cards made by the teacher as the hall-mark of perfection and takes his copy accordingly.

Unless the classroom has a cupboard of a reasonable size with the right kind of deep shelves, the problem of storing apparatus becomes acute. If the walls will allow, wall-pockets are useful for practice cards and do not get too dusty or look unsightly if protected by a brightly embroidered cover. If boxes are used, each should be large enough to hold the cards belonging to one step and should be neatly labelled on the side, so that the teacher is able to see at once which one she wants from the shelf. A foolscap cabinet makes good housing for the smaller type of practice card, each drawer being labelled to show its contents. The rest of the apparatus can be put into boxes, labelled and housed in an improvised cupboard made out of three orange boxes, which will give six divisions in all. If a board of three-ply wood is nailed across the top, and a prettily embroidered curtain fixed round three sides of the cupboard, the effect can be very attractive.

Perhaps the time is near when teachers of young children will be allowed to have a say in the planning of their schools. The ideal room for number activities may then take shape. Space will be the first consideration so that the children can move about easily without interfering with each other. Low cupboards will be provided to contain the essential equipment, including scales and weights, measures for capacity, &c. Finally there will be a sink and tap so that the 'dairyman' will be able to replenish, when necessary, his supply of 'milk'.

In the meantime, since we cannot afford to wait for ideal conditions which may be long in coming, it is surprising what can be done, even in the most unpromising conditions, if the teacher's unfailing stock of imagination and ingenuity is brought to bear. After some initial difficulties and problems have been seen through courageously, the teacher gets her full reward by watching the reaction of the children to this kind of work and the splendid progress they make.

FIRST STEPS IN NUMBER

By DOROTHY WILLIAMS

Illustrated by CAROLIN JACKSON

THESE four little books of simple sums and problems are based on the teaching methods described in *A Realistic Approach to Number Teaching*, and give the children the necessary practice and revision in each step. The child who has been able to master all four books, is ready to tackle Junior School Arithmetic with confidence and ease.

Each page of problems is centred on a topic, and is accompanied by a gay little picture to give a sense of reality to the situation. Book III is especially concerned with Measurement, Length, Weight, and Time, and is very practical in its approach. The child able to tackle Book IV successfully, has a really sound mastery of number up to 24.

NUMBER APPARATUS

THE EDUCATIONAL SUPPLY ASSOCIATION LTD., have in preparation sets of practical apparatus and practice cards, based on Miss Williams's own designs. These should soon be available.

Williams, D.
A Realistic Approach to number Teaching.